CIVIL ENGINEERING

FEBRUARY 195

THE MAGAZINE OF ENGINEERED CONSTRUCTION

See article by Francis S. Friel

• PRESTRESSED CONCRETE WATER TANKS AT NORTH WAYNE, PA. •

CIVIL ENGINEERING, The Magazine of Engineered Construction, February, 1954. Vol. 24, No. 2. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Table of Contents is on page 23

Reflooring old bridge with saves 131,345

THE OLD FLOOR SYSTEM consisted of 6" x 14" wood stringers, 3" wood decking and four lines of ¼" x 30' steel tread plates. Crew is shown removing the outdated floor in preparation for new I-Beam-Lok lightweight steel flooring.

● From the Louisiana State Department of Highways comes another interesting example of the use of I-Beam-Lok on a modernization job.

The project was the reflooring of the 18' roadway of the 767 ft. long Alexandria-Pineville bridge over the Red River in Rapides Parish. The old timber floor was difficult to maintain under the increasingly heavy traffic.

The problem involved finding a suitable flooring that would not add to the deadweight of the supporting structure, yet would be more permanent, and require less maintenance than the existing floor. U·S·S I-Beam-Lok open steel flooring met all requirements.

The engineers estimate that the new floor system including steel stringers, 14,856 sq. ft. of 5" I-Beam-Lok, steel curbs and concrete fill over the pivot pier weighs only 502,914 lbs. for the entire bridge. Compared with a total weight of 634,259 lbs. for the old floor system it replaced, the savings in weight through the use of I-Beam-Lok is 131,345 lbs.

THIS PHOTO SHOWS temporary positioning of a few I-Beam-Lok units on present wood stringers to allow traffic to flow on following morning. These units to be lifted later for installation of permanent steel stringers on which I-Beam-Lok units are to be permanently welded.

BRIDGE WAS KEPT OPEN to traffic each day from 6:00 a.m. to 10:00 p.m. Vehicles moved safely over the newly laid I-Beam-Lok without interruption as all construction work was done late at night.

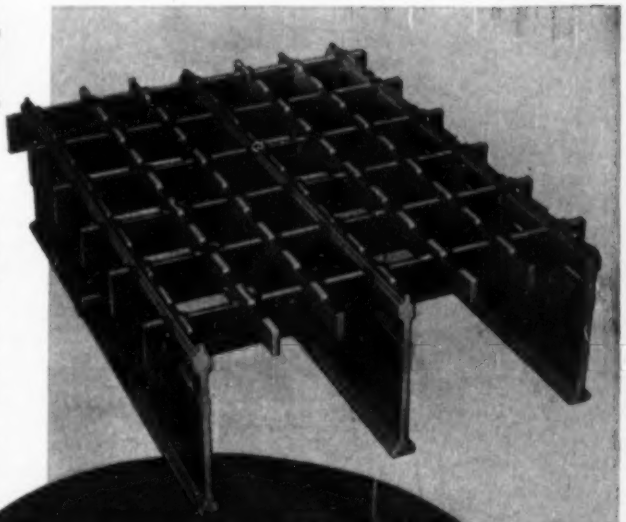
PROJECT: Reflooring of Alexandria-Pineville (Red River) bridge on Routes 5 and 14 in Rapides Parish, Louisiana.

ENGINEERS: State of Louisiana Department of Highways. J. B. Carter, Bridge Design Engineer, Baton Rouge, Louisiana.

CONTRACTORS: Forcum-James Company, Baton Rouge, Louisiana.

U·S·S I-BEAM-LOK

lbs. deadweight



KEPT OPEN TO TRAFFIC

Another important advantage gained through the use of I-Beam-Lok was that the busy bridge was kept open to traffic each day from 6:00 a.m. to 10:00 p.m. while the new flooring was being installed at night.

Available in units measuring 6′-2″ in width and up to 49′ in length, this lightweight, all-steel open flooring with its strong, full 5″ depth can be applied directly to stringers on spans up to 4′ centers to permit H-20 loadings. It does not require secondary supports.

This "modern floor for modern traffic" combines lightweight and reduced costs with roadway rigidity, ease of erection, a smooth, hard surface and low maintenance costs. It is available in both concrete-filled and open types. Our engineers will be glad to discuss its possibilities with you. For more information about U·S·S I-Beam-Lok steel flooring, contact the sales office nearest you.

U·S·S I-BEAM-LOK

the lightweight, long-life flooring for modern traffic

SECTIONS OF NEWLY LAID I-BEAM-LOK were speedily welded together with ordinary field equipment. This lightweight steel open flooring produces a smooth-riding, non-skid, self-cleaning and long-wearing surface.

THIS OVERHEAD VIEW of the newly refloored bridge shows the clean open pattern of U·S·S I-Beam-Lok.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S I-BEAM-LOK

UNITED STATES STEEL

The slag, brick and debris tumbled down in this steel mill open hearth slag pocket to clear the way for furnace relining above. This mass of molten white hot metals and slag along with brick and refractories must be cleaned up quickly — the furnace is out of production until this job is complete.

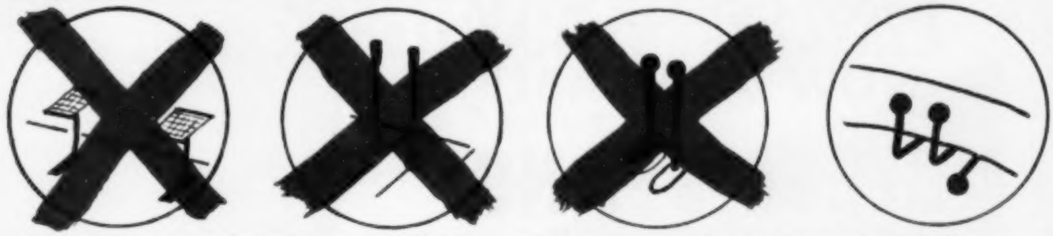
This is considered one of the toughest kind of loading jobs ... it incorporates digging, excavating, prying and loading under intense heat conditions. Previously several types of equipment were used — each for a special function. Now the 105, shown above, is able to replace two or more of these pieces of equipment, speed up the job and get the pocket cleared in record time.

The Eimco 105 picks up the white hot material, ranging in size to 5 or 7 tons, and dumps it overhead into a railroad gondola. (See below.)

Nine yards a minute is fast loading, and you can do it with the Eimco 105. You can dig and load most ordinary materials without preliminary breakage.

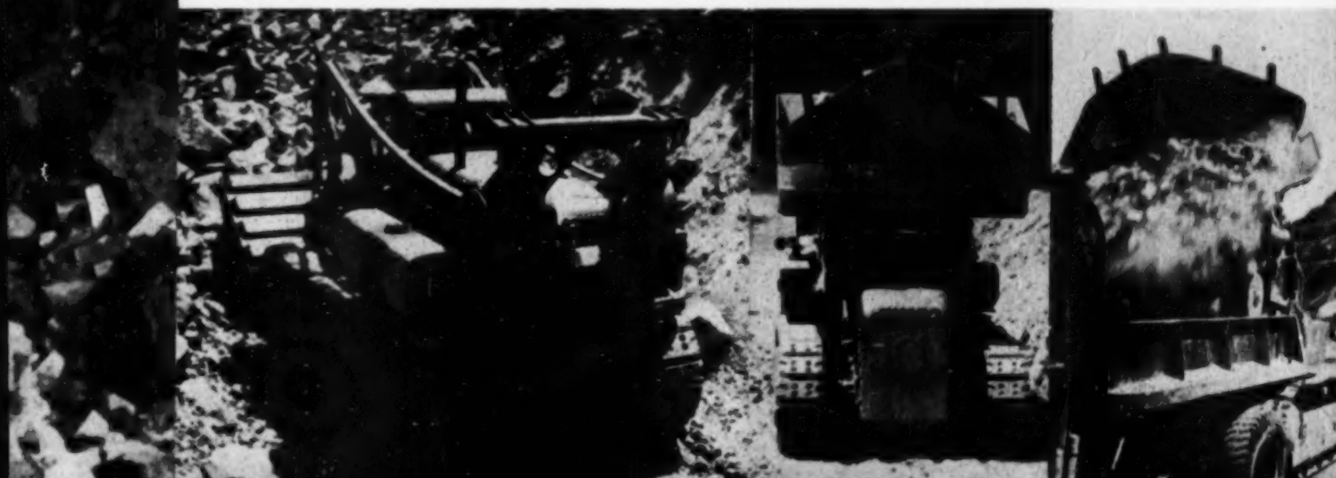
The Eimco 105 is primarily an excavating machine with ability to load consolidated material. It will handle many jobs previously assigned to heavy cumbersome machinery costing several times the price of the 105.

Steel castings and steel construction throughout make the 105 rugged and dependable. It is truly the first crawler unit designed to work under the added thrust and weight loads applied by the numerous attachments now available for contractors and industry that are accepted as part of the prime movers they buy. Its all steel construction makes it resist breakage from impact or abrasion which all machines encounter in normal working.



The 105 is a modern tractor, designed to meet the needs of modern, up-to-date machinery users. The need of clutch pedals has been eliminated, the use of steering brakes has been removed and the need for shifting transmissions by hand is no more. The Eimco 105 works smoothly and efficiently with two small levers which control the tracks on their respective sides. The 105 may be shifted from forward to reverse independently on either track with no clutching — no shifting. Turns can be accomplished by twisting one lever to forward position and the other to reverse to provide spin turns, or longer turns can be effected by proper manipulation of these same handles. Gear changing is done with a separate small handle which may be actuated at any time during the operation of the machine.

The cycle of the loading unit is fast (see below) — digging or excavating is forward, discharge is overhead to the rear. Complete cycles from digging position to digging position average 10 to 15 seconds, which will permit loading of 6 to 9 yards per minute depending on material being loaded and travel distance.

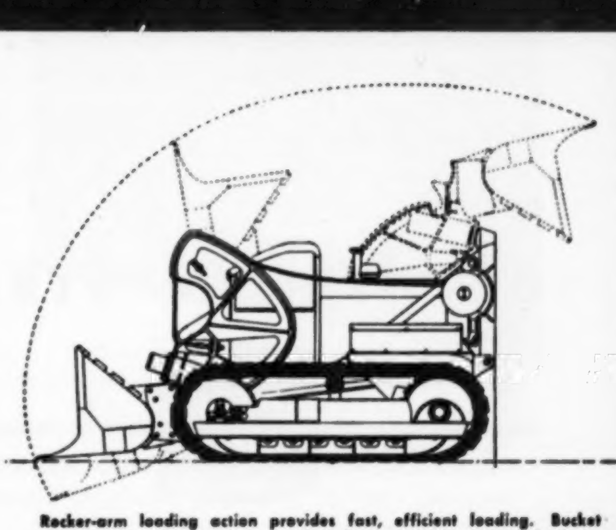


THE EIMCO CORPORATION

Salt Lake City, Utah, U.S.A.

With the 105 you have the first and only truly modern crawler type unit for heavy work. It's fast. It needs only a minimum of attention. It requires the least in physical operating effort of any machine of its type. It will do many things that no other machine will do; and if mechanical attention is ever necessary, its various units are designed for easy accessibility so that the work to be done can be finished in only a fraction of the time required for a similar repair on any other prime mover.

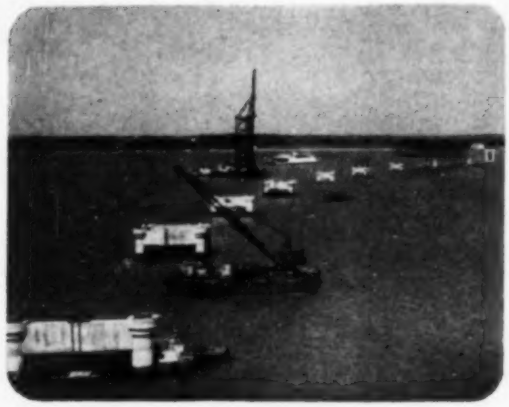
Let us tell you about this machine: where the driver sits up front and can see what he's doing, where the loading equipment is fastened directly to the heavy main frame permitting free track oscillation at all times, that allows for speed changing under full power and load without sacrificing any advantage, that gives you a drawbar pull in the big class with a price in the small class, and many more exclusive advantages. Just write: The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah.



Rocker-arm loading action provides fast, efficient loading. Bucket shown in the digging, carry and discharge positions pictured above.

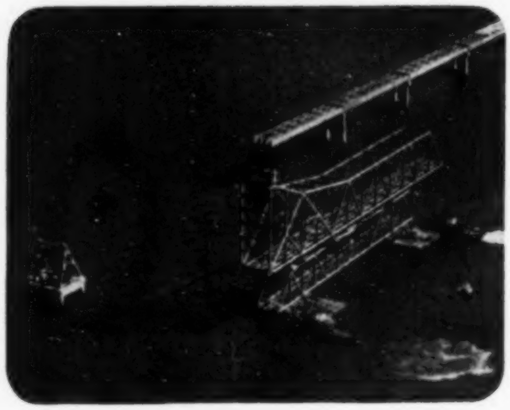
NEW COLOR FILM NOW AVAILABLE

"STEEL SPANS the CHESAPEAKE"

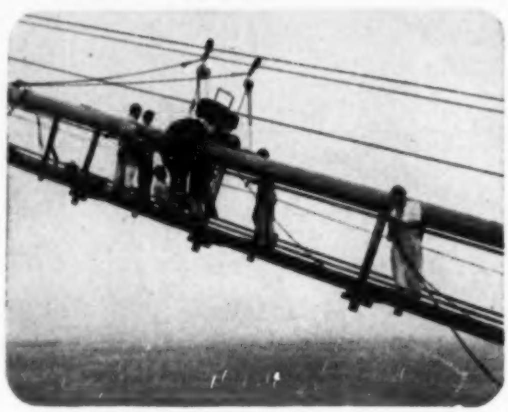


"Steel Spans the Chesapeake," a new 16-mm color film describing the building of the 4-mile-long Chesapeake Bay Bridge, is now available for showings.

This 36-minute film, with factual narration, traces the progress of construction from the sinking of piers to final paving of the roadway. It covers the erection of a wide variety of spans used in the Chesapeake Bay Bridge, including simple beam and girder spans, simple deck-truss, and deck-cantilever-truss spans, a through-truss cantilever span and a 2922-ft suspension bridge.



Among the interesting and unusual erection techniques described in the film is the use of an assembly dock, one mile from shore, where bridge units were assembled, then floated by barge to their final locations. This was the most extensive use of the spectacular flotation method of erection in construction history.



FREE ON REQUEST

There is no charge for the use of this film. We suggest that requests for the film be made *at least* three weeks in advance of the date of showing in order to allow ample time for scheduling and shipment.

Please address your request to: Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

For showings West of the Rockies: Publications Department, Bethlehem Pacific Coast Steel Corporation, 20th & Illinois Sts., San Francisco 19.

For showings in Canada: Bethlehem Steel Export Corporation, 804 Dominion Square Bldg., Montreal, Que., Canada.

BETHLEHEM STEEL

BETHLEHEM STEEL

A Caterpillar No. 12 Motor Grader levels fill on a dike of India's Hirakud Dam.

oil and remove 99% of the dust. Seals keep destructive particles out of important working parts and keep oil in. All engines run efficiently on low-cost No. 2 furnace oil without fouling. This means cheap fuel and less of it, less maintenance and down time.

MAIN DAM, HIRAKUD DAM PROJECT, ORISSA, INDIA

Length of dam	3 miles
Length of dikes	17 miles
Length of concrete sections	4000 ft.
Max. ht. above river bed	195 ft.
Reservoir area	150,C00 acres
Land to be irrigated	2,000,000 acres
Power potential	300,000 KW
App. cost of project	nearly $2 billion

There are other definite advantages for standardizing on rugged yellow equipment. Many parts are interchangeable. There's one source for parts and service—the Caterpillar Dealer. Maintenance men are more efficient on familiar machines. Operators get more work out of them.

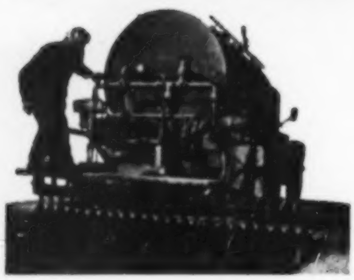
Your Caterpillar Dealer has performance data on all sorts of jobs. He'll be glad to give you complete facts. Phone him today—ask him to demonstrate on your toughest job.

A big yellow DW21 with No. 21 Scraper loads and hauls fill on dam construction near Orissa, India.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Both Cat and Caterpillar are registered trademarks—®

BITUMULS® leads in surface treatment work!



You will be interested in these facts obtained in our recent nation-wide survey:

- In the past five years most of the states in the union have *increased* the volume of sealing and surface treatment work done with asphalt emulsions.
- A majority of the counties in the country now *prefer* the use of emulsions to hot asphalt, tar and cutbacks for surface treatments.

BITUMULS LEADS ALL OTHER EMULSIONS for work of this type. As a pioneer product for Surface Treatments, Bitumuls continues as first choice of road-builders everywhere. It has won acceptance based on speed and ease of application, dependable performance, and long economical service. Bitumuls HV (high viscosity emulsion) holds more cover stone than any other binder. It sets-up faster, and provides a safe, non-skid surface.

Our new booklet, "BITUMULS SURFACE TREATMENTS AND PENETRATION PAVEMENTS," gives full details on all types of Surface Treatments, Single, Double and Triple. There are Bitumuls Engineers working out of offices near you who will welcome an opportunity to discuss your Surface Treatment work.

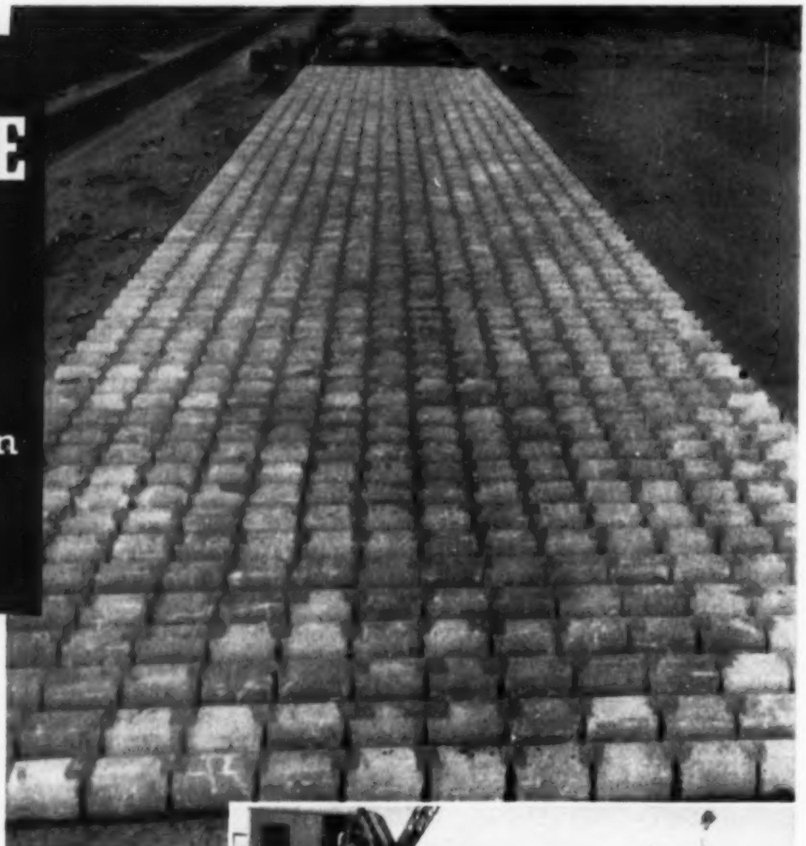
AMERICAN Bitumuls & Asphalt COMPANY

200 BUSH STREET, SAN FRANCISCO 4, CALIFORNIA

E. Providence 14, R. I. · Perth Amboy, N. J. · Baltimore 3, Md. · Mobile, Ala. · Columbus 15, Ohio · Tucson, Ariz. · Seattle, Wash. · Baton Rouge 2, La. · St. Louis 17, Mo. · Inglewood, Calif. · Oakland 1, Calif. · Portland 7, Ore. · Washington 5, D. C. · San Juan 23, P. R.

CONCRETE PIPE

provides economical flood protection for highways



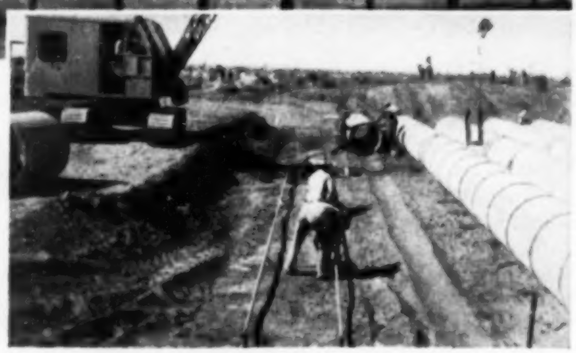
In a 20-mile stretch of new highway along U. S. 70 and 80 between Las Cruces and Lordsburg, N. M. 52,000 linear feet of 30-in. and 36-in. concrete pipe are used for culverts.

Multiple-course concrete pipe culverts spread out the flood waters coming down narrow arroyos across the highway. They reduce vertical erosion damaging to the highway and eliminate sharp dips in the pavement that slowed traffic on the old, culvertless highway.

Illustrated here is the largest installation in this project. Containing 183 parallel courses of 30-in. concrete pipe laid 15 in. apart, it uses 11,712 ft. of pipe and extends 912 ft. along the road. Each course consists of 16 pipe sections each 4 ft. long.

This is another example of how concrete pipe culverts can meet any combination of site conditions and drainage requirements. Concrete pipe culverts have rendered outstanding service in thousands of highway installations and under the lines of most of the nation's leading railroads.

Concrete pipe culverts have adequate strength to sustain heavy overburdens and to resist severe impact. Their smooth interior walls and clean, even joints assure maximum hydraulic capacity. Their moderate first cost, long life and low maintenance expense result in true ***low-annual-cost*** service.



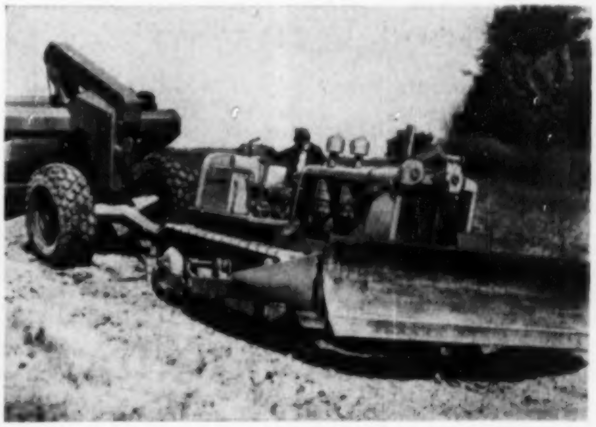
Top photo shows extent of installation before backfilling. Photo above shows (1) pipe runners used to carry circle screed, (2) cradle in sand formed by screed, (3) installed pipe lines. Photo below shows backfilling operation.

AMERICAN CONCRETE PIPE ASSOCIATION

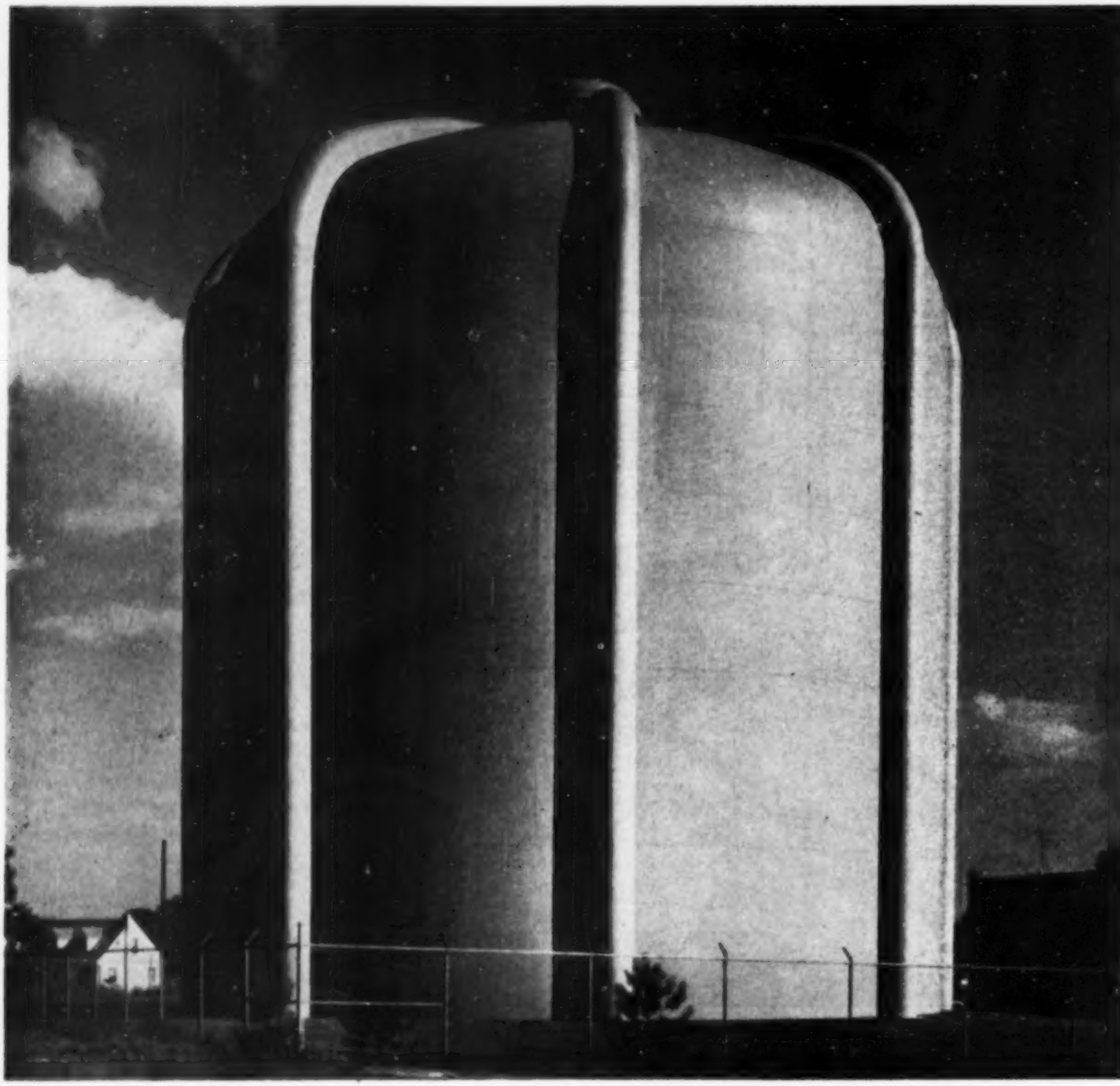
228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

Constant progress in earth-moving methods has been matched by such design advances as this HD-15 and its engine-mounted dozer . . . which were engineered and tested as a unit, right from the start.

This HD-15 Tractor Shovel is a tool which introduced a new era of tractor usefulness . . . let contractors move from job to job easily and do traditional jobs in a better, faster way.



The improvements and refinements of really modern design take on new significance as competition gets keener. Extra yardage handled . . . or lubrication time saved means working more efficiently, more profitably.



Good Water Service Doesn't Just Happen . . .

. . . it is a planned, engineered and carefully built system of mains, pumps, treating plants and storage facilities. Water at the turn of a tap may be taken for granted by the average consumer—but not by the people behind the service.

Helping to provide an adequate water supply to meet all demands at Clifton Heights, Pennsylvania, is the job of the modern 3,000,000-gal. Horton standpipe shown above. It was designed, fabricated and erected by Chicago Bridge & Iron Company for the Philadelphia Suburban Water Company.

In residential installations, where appearance can be an important factor, the Horton standpipe above illustrates how municipal water storage facilities can be made as attractive in appearance as they are functional in operation. Exterior modifications can be made to meet individual specifications.

Horton reservoirs and standpipes are built in standard sizes up to 10,000,000 gallons. Complete information, estimates or quotations may be obtained by writing our nearest office. There is no obligation.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3................2167 Healey Bldg.
Birmingham 1..........1596 N. Fiftieth St.
Boston 10........1009—201 Devonshire St.
Chicago 4..........2199 McCormick Bldg.
Cleveland 15...........2263 Midland Bldg.
Detroit 26............1541 Lafayette Bldg.
Houston 2............2128 C & I Life Bldg.
Los Angeles 17..1556 Gen. Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
Pittsburgh 19.............3210 Alcoa Bldg.
Salt Lake City 4.....509 West 17 South St.
San Francisco 4........1584—200 Bush St.
Seattle 1................1309 Henry Bldg.
Tulsa 3..................1647 Hunt Bldg.

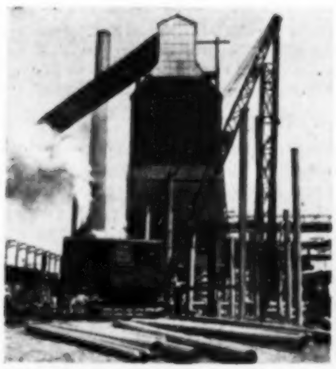
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

MONOTUBE PILES
for all types of structures

FOR small jobs . . . for the biggest or toughest jobs . . . you'll find Monotube fluted steel piles are more and more often the carefully considered choice for *all kinds* of foundation work.

There are good reasons for such choice—exceptional strength and high load bearing values, combined with light weight for easier handling and driving. Simplified on-the-job extendibility. Complete top-to-bottom visual inspection before concreting. Jobs go smoothly and fast! Less waste. Less time. Less cost!

Get all the facts. Write to The Union Metal Manufacturing Co., Canton 5, Ohio, for Catalog No. 81.

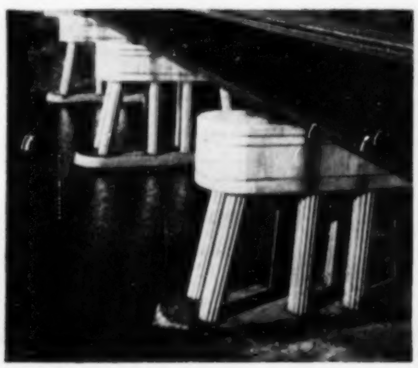


INDUSTRIAL PLANTS

BUILDINGS

BRIDGES

PIERS



RAILROAD STRUCTURES

EXPRESSWAY OVERPASSES

UNION METAL

Monotube Foundation Piles for every foundation problem

Cantilever Design and 'INCOR' Cut School Building Costs

Engineering and Building Know-How Provides Fire-Safe Construction, at 20% to 25% Saving

● All-concrete school construction, the utmost in fire-safety, is a great community asset—safeguarding the lives of children, adding immeasurably to parent peace of mind, saving public funds through lowest annual cost—with lower first cost as well, through sound planning, well exemplified in this new Indianapolis school.

Columns form central corridor with cantilever beams at 17'-2" centers extending out over exterior walls of classrooms. Small concrete ribs at right angles to beams carry precast, lightweight concrete roof slabs with excellent insulating and acoustical properties; ¾" insulation was added to exposed ribs.

Thus, roof deck, insulation and acoustical ceiling are combined in one material and installed in one operation. Furred-down corridor ceilings provide space for exhaust ducts.

Two adjacent cantilever sections, equal to width of two classrooms plus overhang, form the auditorium, with floor lowered for additional height.

Total Cost, 92¢ per cu. ft.

Repetitive structural system and the use of 'Incor'* 24-Hour Cement resulted in maximum form re-use and a substantial saving in construction time and overhead—as reflected in a total cost of 92¢ per cu. ft., 20% to 25% less than comparable buildings in the area.

Well-thought-out design, translated into efficient concreting schedules based on dependable 24-hour service strengths with America's FIRST high early strength portland cement, means better building at less cost, both initial and ultimate.

*Reg. U. S. Pat. Off.

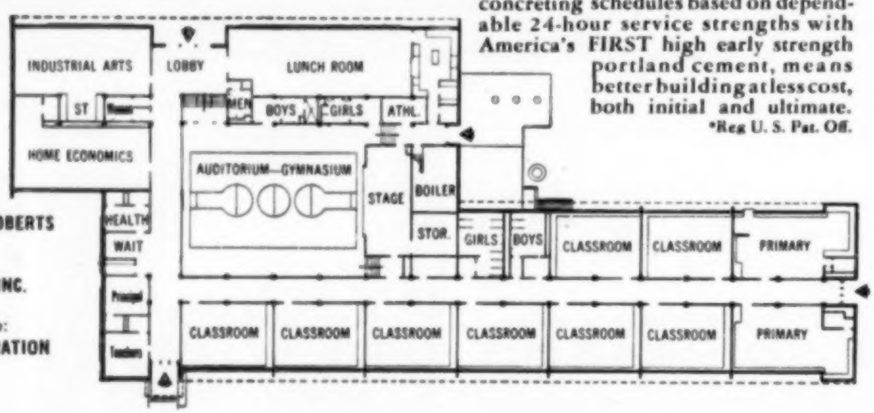
MERLE E. SIDENER SCHOOL
P.S. 59
Indianapolis, Indiana

Architects:
DAGGETT, NAEGELE & DAGGETT INCORPORATED

Consulting Engineers: **FINK & ROBERTS**

Contractor:
CANNON CONSTRUCTION CO., INC.

Ready-Mix 'Incor' Concrete:
READY MIXED CONCRETE CORPORATION
all of Indianapolis



LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA. • BIRMINGHAM • BOSTON • CHICAGO • DALLAS • HOUSTON • INDIANAPOLIS • KANSAS CITY, MO. • NEW ORLEANS • NEW YORK • NORFOLK • PHILADELPHIA • RICHMOND • ST. LOUIS • WASHINGTON, D. C.

LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 18 MODERN MILLS, 136,000,000 SACKS ANNUAL CAPACITY

Subscription Rates—Price 50 cents a copy. $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

Member Audit Bureau of Circulations
42,800 copies of this issue printed

CIVIL ENGINEERING

FEBRUARY 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• CONTENTS • VOLUME 24 • NUMBER 2

• SOCIETY NEWS

• NEWS BRIEFS

• DEPARTMENTS

Extension brings Canadian crude oil to East in pipeline 1,770 miles long

CLARK ROOT, Assistant Project Engineer, Bechtel Corporation, Saginaw, Mich.

The Lakehead Pipeline Extension, 644 miles long (Fig. 1), was born of economic necessity. As the Great Lakes are closed to shipping through five winter months, tanker shipments were seasonal, making it necessary to provide large storage capacity at both ends of the tanker routes to allow for the winter shutdown. Increasing demands for crude oil meant enlarged tanker fleets plus more and more terminal storage. The new pipeline extension, in addition to reducing the cost of transporting crude, provides a year-round supply for Sarnia refineries and others now existing or to be constructed along the line. It increases the crude-oil supply to the eastern part of the North American continent and contributes materially to hemisphere security and defense.

The present extension, from Superior, Wis., to Sarnia, Ontario, connects with the continuous crude-oil pipeline which was built a little more than three years ago from Edmonton, Alberta, to Superior, at the head of the Great Lakes, a distance of 1,126 miles. That part of the line from Neche, N. Dak., near the International Boundary, to Superior is owned and operated by the Lakehead Pipe Line Co., Inc., an American corporation, which is a subsidiary of the Interprovincial Pipe Line Co., owner and operator of the Canadian section of the line.

This line made it possible to transport crude oil from the richly productive fields of Alberta to the East. Part of the line has a diameter of 16 in., part 18 in., some 20 in. In addition to the terminal storage and loading facilities at Superior, off-take connections were provided for refineries in Minnesota and Superior, Wis. From Superior, before the present extension was built, the oil

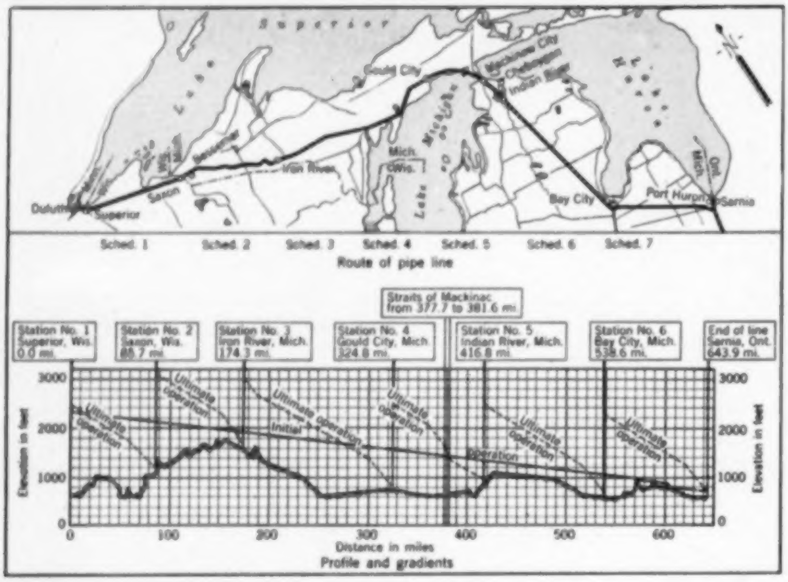


FIG. 1. Lakehead Pipeline Extension runs 644 miles, from Superior, Wis., to Sarnia, Ontario. Ground profile and hydraulic gradients for initial and ultimate operation are given in graph below map.

Ditcher (above) made good headway, once trees and brush had been cleared. Pipe was bent in machine shown below, to conform to ground contour, before welding. This method was found more practicable than trying to maintain level trench through uneven terrain.

had to be transported by a fleet of tankers through the locks at the Soo, and so to various ports in both the United States and Canada. The major part went to Sarnia, in Ontario, the terminus of the present extension.

The new 644-mile line, of 30-in. diameter, extends from Superior across Wisconsin and the Upper Peninsula of Michigan to the Straits of Mackinac. Here a major construction feat was accomplished in carrying the line for a distance of 4 miles across the Straits in two parallel pipelines each of 20-in. diameter, 1,300 ft apart, which lie on the bottom. On the south shore, the two lines rejoin (Fig. 1) in a 30-in. line which runs southward across the Saginaw River near Bay City just south of Saginaw Bay and then southeast to cross the international boundary in the St. Clair River at Marysville near Port Huron. Emerging from the river, one of the busiest shipping lanes in the world, it connects with refineries in Sarnia, Ontario.

Ultimate capacity of the line will be 300,000 bbl per day. Initial operation, with one pumping station at Superior, calls for 120,000 bbl per day. Future pumping stations necessary to reach maximum capacity are planned near Saxon, Wis., Iron River and Gould City in the Upper Peninsula of Michigan, and Indian River and Bay City in the Lower Peninsula. The addition of this 644-mile extension to the 1,126-mile length from Edmonton, makes the total of 1,770 miles one of the longest continuous crude-oil pipelines in the world.

Three major water crossings, at the Straits of Mackinac, the Saginaw River, and the St. Clair River, add to the engineering interest of the line. The Straits crossing, in depths up to 248 ft, represents one of the deepest water crossings in pipeline construction history.

In the initial planning, two possible routes were considered. One was via Chicago around the southern tip of Lake Michigan; the other via the Straits of Mackinac, a bolder but shorter route. Preliminary surveys of both were made by scouting parties in autos and by air. The shorter route across the Straits was selected.

Work got under way rapidly in January of 1953. From available

county, state, and federal maps of the area, a series of route maps on a scale of 1 in. to the mile was developed showing the principal physical, political, and cultural features. The aerial survey and photography were started simultaneously, and a proposed line was plotted on the route maps. Armed with these, groups of pipeline locators and survey parties, often on snowshoes, started into the field to stake out the line.

Using aerial mosaics on a 3 mile-wide strip and by means of three-dimensional stereopticon projection, a series of strip maps on a scale of 1 in. = 1,000 ft was developed showing the chosen location. These maps depicted with excellent accuracy the various parcels of land needed for right-of-way as well as topographic details such as towns, buildings, rivers, swamps, lakes, and woods. These strip maps were also used by the right-of-way procurement personnel so that each location survey party was preceded by an agent obtaining permits to survey as well as options on the land.

The preliminary field survey was started simultaneously on seven main-line schedules averaging 90 miles each, plus a short section of 8 miles in Sarnia, Ontario. Two parties were used on each of the longer schedules. Much credit must be given to these crews for accomplishing a very difficult assignment in a minimum of time. The work commenced in the dead of winter, when deep snows and impassable roads added to the difficulties. Many times it was necessary to call out crews with road patrols and bulldozers to break trails into the line location from the main highways. Rough terrain and heavy timber aggravated the problem. And above all there was the constant pressure of time.

Construction was scheduled to start in May, just as soon as weather permitted, and the line had to be staked and right-of-way obtained before any construction could begin. By starting many parties at several different points, it was possible to commence clearing operations on the first of May on each of the seven main-line spreads.

To assist in the construction of the line and to wrap up the final mapping program, a field survey party was assigned to work on each of the eight main-line spreads as well as on the three major water crossings. The functions of these parties were threefold: to restake the line after clearing and grading of the 60-ft right-of-way; to establish a profile of the finished line; and to make a complete in-

Above:
Rotary cleaning and priming machine wire-brushed off dirt and loose scale and applied coal-tar primer.

Right:
Coat-and-wrap machine, self propelled, of rotary type, was supported by side-boom tractor. It applied protective coating of coal-tar enamel into which was impregnated spiral wrapping of glass-fiber matting, followed immediately by additional spiral wrapping of glass cloth.

Below:
Pipe was lowered into trench by two or three side-boom tractors equipped with slings. After backfilling, right-of-way was graded and harrowed and fences replaced.

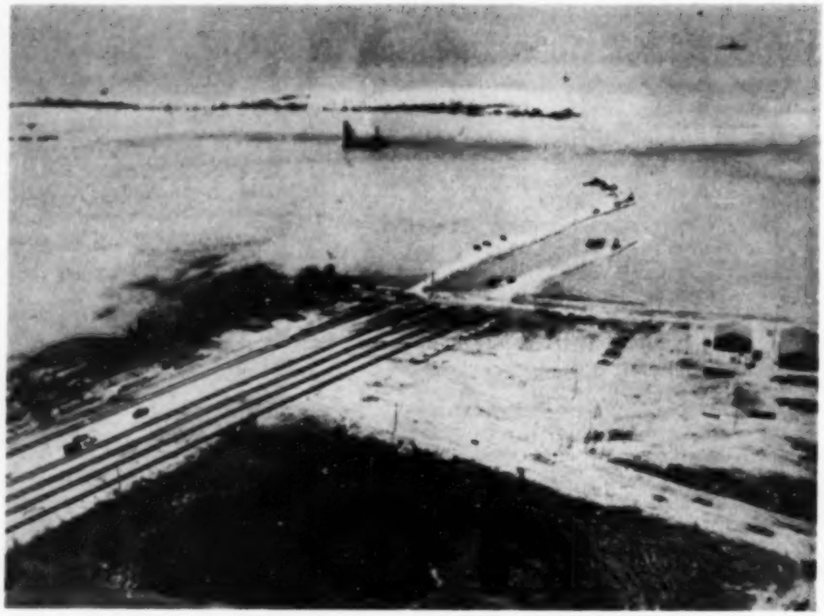
ventory survey of the line, including all materials going into the construction of the line. From these data and field notes, a complete and accurate set of "as-built" drawings was developed, an absolute necessity as far as the owner and operator is concerned.

Initial operation of the line calls for 120,000 bbl per day pumping for the entire 644-mile route, to be done from a pumping station at Superior, Wis. Later, five additional pumping stations will be added, increasing the capacity to its ultimate of 300,000 bbl per day, as previously stated. Main-line pumps at the Superior Station consist of three units operating in series with a total capacity of 300,000 bbl per day. These are Bingham $14 \times 14 \times 16\,^1/_2$ single-stage pumps driven through Farrell Birmingham speed increasers by Nordberg 1,760-hp, 500-rpm diesel engines. Fuel for the engines is crude oil taken directly from the line.

The major part of the line is of high-strength expanded, welded pipe, delivered in 40-ft lengths. It has an outside diameter of 30 in. and a $^9/_{32}$-in. wall thickness. There are some few miles of $^3/_8$, $^5/_{16}$ and $^{11}/_{32}$-in.-wall pipe at the discharge from pump stations and within city limits. River crossings have a $^1/_2$-in. wall thickness. The Mackinac Straits crossing consists of two parallel lines, 1,300 ft apart, using seamless pipe of 20-in. outside diameter and 0.812-in. ($^{13}/_{16}$-in.) wall thickness.

The Saginaw River crossing consists of 3,100 ft of concrete coated pipe of 30-in. outside diameter and $^1/_2$-in. wall thickness, buried under the river for the entire crossing. The river, though navigable to lake steamers, is relatively shallow and fairly wide, with swampy approaches. There is little current and the water level rises and falls depending on the direction of the wind on Lake Huron into which the river flows within a few miles.

The St. Clair crossing consists of 2,700 ft of similarly coated pipe, also of $^1/_2$-in. wall thickness. It is also buried for the entire crossing. The St. Clair River is one of the busiest shipping lanes in the world. It is 40 ft deep and has a steady current at the crossing of about 7 miles per hour, flowing from Lake Huron to Lake St. Clair near Detroit.



Mackinac crossing a major feat

The Straits of Mackinac crossing (Fig. 2) is one of the major engineering and construction feats of the pipeline industry. Two 20-in. lines, 4 miles long, were laid to a maximum depth of 248 ft. Whereas the relatively thin-wall pipe for other water crossings had to be weighted by river anchors or concrete coating, the heavy wall of the 20-in. lines had to be buoyed up at intervals with pontoons to reduce the negative buoyancy to 6 lb per ft to prevent the pipe from gouging out the bottom during pulling. These pontoons were released after the pipe had settled into place. Except for those portions near the shore, at depths less than 65 ft, where the pipe was buried in a trench for protection, the lines were laid on the bottom of the Straits.

Main-line construction followed a fixed, well-organized pattern. After clearing and grading operations were completed, a ditching machine, cutting a trench $5^1/_2$ ft deep and 42 in. wide at the bottom, with slightly sloping sides, progressed along the staked line on the right-of-way. A minimum cover of 3 ft was required over the pipe. Forty-foot sections of pipe were strung along the ditch and welded into a continuous length. The pipe was bent to conform to the contour of the ground, where necessary, before welding. This has been found to be more practical than trying to maintain a level trench through uneven terrain.

Then a rotary cleaning and priming machine was run along the pipe, wire-brushing the dirt and loose scale and rust off the pipe and applying a coat of coal-tar primer. The cleaning and priming machine was followed by a coat-and-wrap machine. This is a rotary type, self-propelled machine, supported by a side-boom tractor, which applies a protective coating of coal-tar enamel into which is impregnated a spiral wrapping of glass fiber matting, followed immediately by an additional spiral wrap of glass cloth. The continuous coated and double-wrapped pipe was then lowered onto skids alongside the trench preparatory to lowering-in.

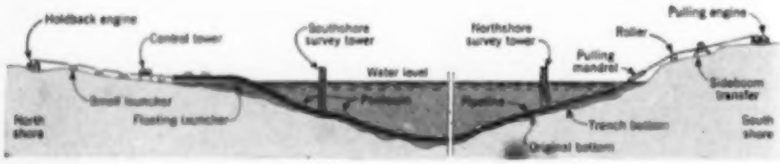
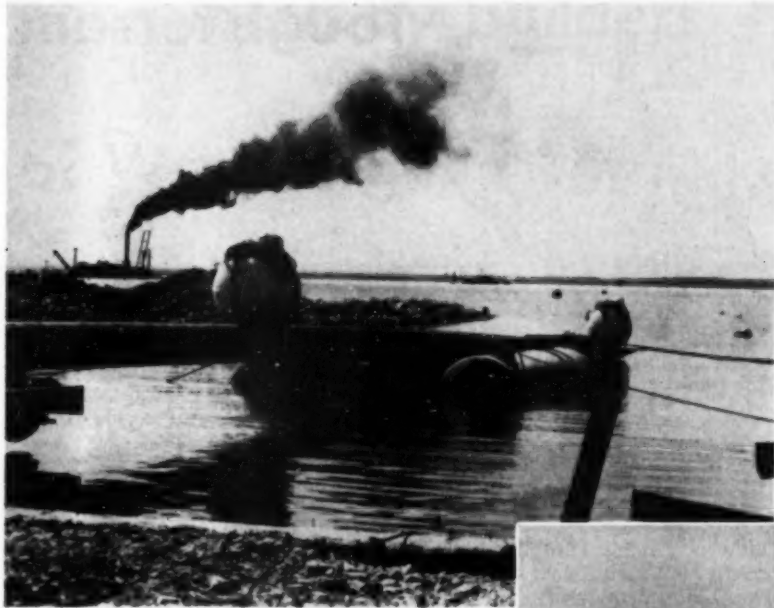
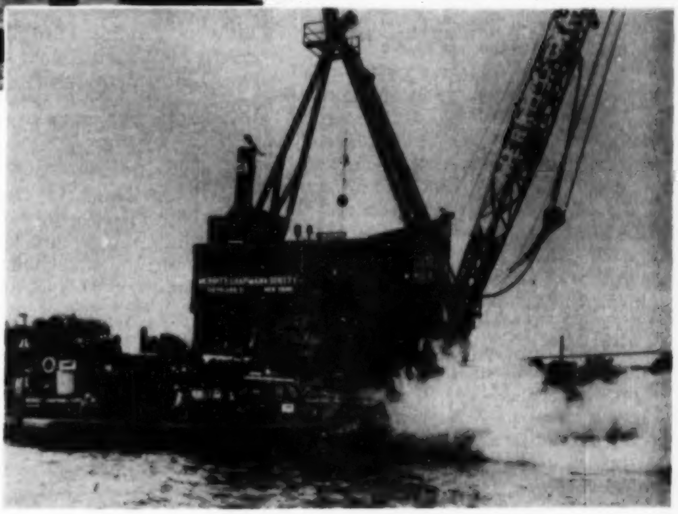


FIG. 2. Twin lines of 20-in. diameter were pulled by cable 4 miles across Straits of Mackinac. Near shore, in depths less than 65 ft, pipe is in trench for protection; elsewhere it rests on bottom.



Air view (far left) shows pipe being assembled on north shore of Mackinac Straits in sections 2,500 ft long (8 to a line), ready for pulling across. View at left shows first section of pipe on August 9, 1953, soon after it was started out across Straits. Buoys ride pipe at regular intervals. Before pipe could be pulled into place, 2-in. cable had to be pulled across Straits and connected to first section of pipe. In view below, barge ***Cherokee*** of Merritt-Chapman & Scott (which held contract for crossing) has 4-mile-long cable in tow while G.M. diesel-powered tender ***Lakehead*** stands by to handle utility jobs.



Three types of tests were run on the pipe. After the welding, a representative sampling of 10 percent of the welds were X-rayed for defects. Defective welds were few. Then a testing pig or scraper was blown through each section of the line by compressed air, in lengths not to exceed 5 miles. This was necessary to assure that the line was free from water, dirt, small animals, and other foreign objects, and also free of defective workmanship such as welding icicles and flattened pipe bends. Prior to lowering-in, a holiday detector or "jeep" was run along the pipe to detect any flaws in the coat-and-wrap covering; any found were immediately patched by hand.

The pipe was then lowered into the trench with two or three side-boom tractors with slings, and the trench backfilled. Finally, the right-of-way was carefully graded and harrowed, fences were replaced, and the land restored to its original condition as nearly as possible.

Final hydrostatic testing of the line was done with water pumped in at Superior. Sections between test valves vary in length from a few miles to 110 miles, depending on the line profile and the hydraulic gradient. In general, the test pressure was at more than 125 percent of the expected operating pressure but did not exceed 90 percent of the yield strength of the pipe. A maximum length of 115 miles of water was used to test the sections in progression from Superior to Sarnia. This water section was pushed along by oil, separated from the water by a gaging scraper or pig. In this way, after the final test was completed on the last section at Sarnia, and the water discharged from the line, it was completely filled with oil and ready for operation. Approximately 2,800,000 bbl of oil were required to fill the line.

Welding of the line was completed just six months after the first clearing and grading operations commenced on the right-of-way, and just five months after the first ditching operation. The last welded tie-in was made on November 2, 1953.

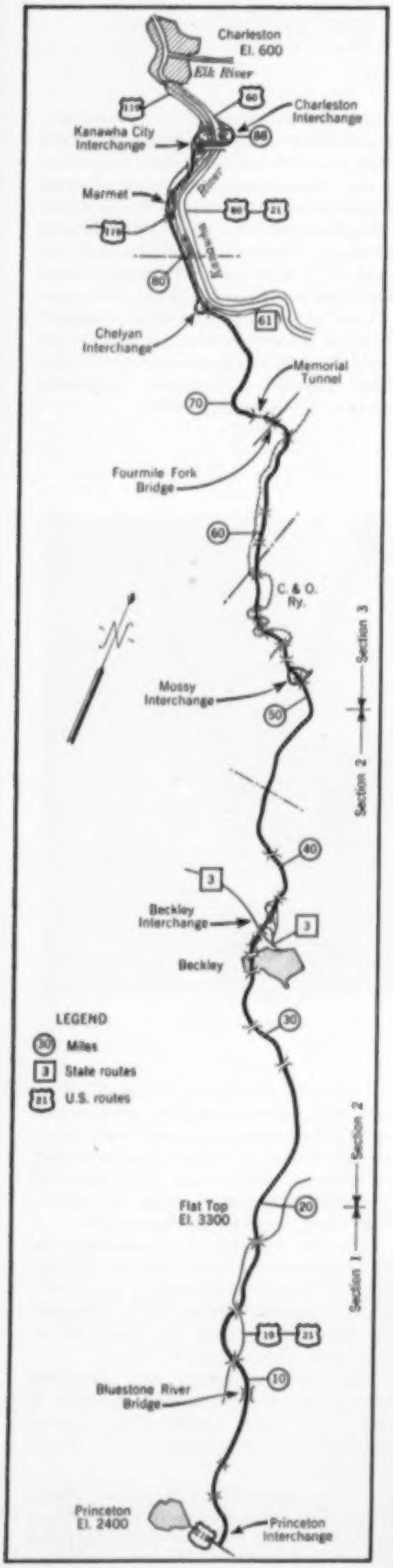
The total cost of the project, including the initial pumping station at Superior, will be just under $70,000,000.

As Managers of Construction, Bechtel Corp. acted as agent (not prime contractor) for the Lakehead Pipeline Co. The main-line contractors were: Mahoney Construction Company, Anderson Bros. Corporation, Midwest Constructors, Inc., Bechtel Pipeline Division, Conyes Construction Corp., and F. E. Shaw, Ltd.

For the major water crossings, the contractors were: Straits of Mackinac, Merritt-Chapman & Scott Corp.; Saginaw River, W. J. Meagher & Sons, Inc.; and St. Clair River, Midwest Constructors, Inc.

Preliminary survey and mapping were done by Lockwood, Kessler & Bartlett; and engineering, design and material procurement, by Bechtel Corp.

(This article is based on the paper originally presented by Mr. Root before the District 7 Conference, held at the Michigan College of Mining and Technology, Houghton, Mich.)



Tough terrain

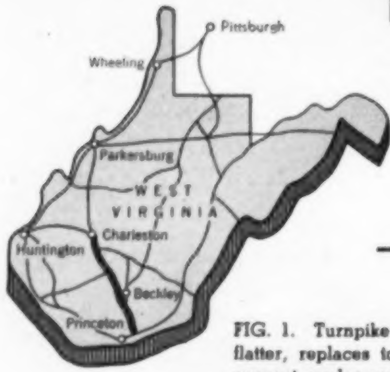


FIG. 1. Turnpike 88 miles long, with grades of 5 percent or flatter, replaces tortuous route 107 miles long with some 9-percent grades and curves on 50-ft radius. Along some watercourses, new channel had to be cut to permit turnpike to share narrow strip with existing state road and railroad.

The West Virginia Turnpike marks a forward step in the field of expressways and superhighways, primarily because, although it was conceived as a four-lane divided highway, it is being constructed in a preliminary stage generally two lanes in width. It marks a dramatic step forward also, because it is being built to very high standards of line and grade through terrain that had been considered practically impossible to tame for modern turnpike construction.

Obstructions have been formidable, including the opposition of those who, governed by understandable regional pride, could not support a facility lesser in appearance, if not necessarily in fact, than those in other areas where full dualization is justified by the combined advantages of greater revenue-producing traffic and lower construction costs. Stage construction became such a public issue that it had to be settled by a court action that brought all construction work to a standstill for three months in 1952, during perfect fall construction weather. Despite the controversial din that might have seemed calculated to move mountains, the mountains remained unchanged. When the smoke had cleared away and the Commission's decision had been legalized in an exceptionally laudatory manner by the federal court decision, the mountain barrier was as formidable as ever, and only those contractors of proven fortitude heeded the call to join in attacking it.

The problem was to construct a superior limited-access turnpike from Charleston, W.Va., southeasterly to Princeton, W.Va., a distance of 76 airline miles, 88 turnpike miles, and 107 miles by the shortest existing highway. See Fig. 1. The old highway followed a tortuous route, sometimes with grades of 9 percent and curves of 50-ft radius. By comparison, the turnpike boasts grades designed to a desirable maximum of 3

Sample terrain shows what grading contractors were up against on West Virginia Turnpike. Grading, done on unit price basis, averages $1.30 per cu yd for excavating, hauling, spreading, and compacting. Latrobe Road Construction Co. here is breaking ground with tractor-drawn pans near Mile 36.

conquered by builders of West Virginia Turnpike

C. H. PETERSON, A.M. ASCE

Project Engineer

Howard, Needles, Tammen & Bergendoff

Charleston, W.Va.

Heavy equipment worth 30 million dollars moves 30 million cubic yards in major grading job

percent and an absolute maximum of 5 percent. Curves have a minimum radius of 1,000 ft. Sight distance on the turnpike is not less than 600 ft, which is the acceptable non-passing criterion for speeds of 60 miles an hour on the ultimate dualized facility. In the initial stage, non-passing curves are infrequent and are interspersed generously with areas of long sight distance.

A further comparison between the old route and the turnpike can be made on the basis of the maximum deviation from a straight line drawn between the terminal points. The shortest existing highway deviates from such a straight line as much as 11 miles, while on the turnpike the maximum deviation has been reduced to 6 miles on one side of such a line and less than 2 miles on the other side.

Enormous difficulties appeared when preliminary efforts were made to select a location from federal geological maps with a 50-ft contour interval. In their lower reaches, various streams (or hollows as they are more aptly described on the job) appeared to offer real possibilities. However, as the line progressed across the sheet to the head of such a hollow, the 50-ft contours invariably were crossed with increasing rapidity until little was left but a 45-deg slope absolutely incapable of adaptation for superhighway construction.

After the initial line was established, a map with a 5-ft contour interval was prepared from aerial photographs. Although this map covered nearly 200 lin ft of blueprint paper, it did very little to ease the problem of flattening the mountains. Many sheets took on the appearance of finely spaced cross-hatching that would delight a student draftsman but caused spots before the eyes of the location engineer, striving to select an alignment combining reasonable economy with superior characteristics. Through particularly difficult sections, as many as 27 alignments were detailed in varying degrees before the most suitable was found. Sometimes a line shift of 25 ft resulted in unbelievable differences in yardage and cost of construction. At some locations, line and grade changes were made after construction started, to alleviate slide conditions, to correct difficult foundation conditions for side-hill embankments, or to improve the balance between cut and fill quantities, especially where final design information differed appreciably from the less detailed preliminary data.

In spite of the rough topography, only one tunnel, 2,664 ft long, was required. Some concept of the precipitous nature of the terrain in this area can be gained from the ground profiles. The roadway grade is 600 ft below the ridge line at the center of the tunnel and 282 ft above the ground level at Fourmile Fork Bridge, which adjoins the south portal of the tun-

Rock areas required blasting. At left below, Groves, Lundin & Cox, Inc., operates battery of compressors and wagon drills in preparation for shooting near Mile 65. At right below, Ralph E. Mills Co. and Morrison-Knudsen Co. are attacking rock cut near Mile 75 with $3^{1}/_{2}$-cu yd Lima shovel and string of end-dump Euclids. Power shovels, usually of $2^{1}/_{2}$-cu yd capacity, excavated rock cuts. Contractors have mobilized 60 power shovels for their jobs and consistently have moved a million cu yd per week.

Top photo: On Flat Top near Mile 18, state highway (to left) had to be relocated for $3\frac{1}{2}$ miles to make way for Turnpike. Condon-Cunningham Co. and Peter Kiewit Sons' Co. are handling this section. **Directly above:** High fill at Mile 11 required largest culvert on project—a 138-in. bituminous-coated metal pipe with paved invert. Pipe was factory strutted and bedded in crushed stone in trench. Fill measures 180,000 cu yd, all earth and rock talus. Borrow came from slide area in upper right of photo and was hauled in 20-cu yd tractor-drawn scrapers which were push loaded. Fill was compacted to 96 to 100-percent modified Proctor density with 60-in. sheepsfoot rollers. Contractor, Ralph E. Mills Co., spread layers with dozer and motor patrol.

nel, a total change in ground elevation of nearly 900 ft in a horizontal distance of 1,900 ft. At the Bluestone River Bridge, the roadway is 264 ft above the bottom of the gorge, and there are several minor bridges with spans up to 120 ft where the roadway deck is over 90 ft above the natural ground level.

Much yardage wasted

Grading is heavy, 60 percent of all excavation being rock. The entire project is classified as a waste job. In many areas where cuts and fills were estimated to balance, cuts overran slightly because of swell in the rock fills. A very few locations required an insignificant amount of borrow because of restrictive overhauling conditions. In most areas, particularly those with heavier grading sections, side-hill excavation was benched into solid formations for full roadway support. This resulted in large quantities of excavation in excess of those required to form embankments within reasonable haul limits. Excess material was used in so far as economical to form the additional embankment required for ultimate dualization. The remainder was wasted by filling hollows and ravines adjacent to excavation areas.

All side-hill embankments were placed on ground that had been carefully benched into solid material. Benches, cut with vertical faces, were often as wide as 20 ft. All embankment was laid in layers of controlled thickness (8 in. for earth and 24 in. for rock) and thoroughly compacted. In-place density tests were specified and used to a limited extent but were found to be impracticable in many materials because of the high percentage of rock larger than 1 in.

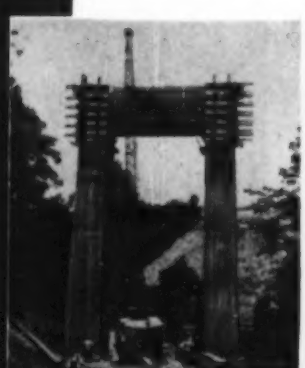
All rock fills were thoroughly compacted with flat-wheel, heavy-duty sheepsfoot or rubber-tired supercompactor rollers with particular attention to soft and medium shales that could be broken down under the compactors. Compaction was controlled largely by constant and careful inspection of the embankment as it was being placed. Particular note was taken of the behavior of the materials under the rollers, and rolling was continued until all evidence of movement of the embankment materials ceased.

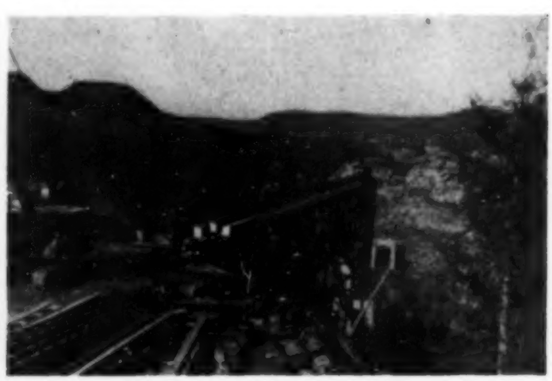
More slides were experienced than anticipated or desired. This experience indicates clearly the need for detailed preliminary geologic and soil studies in areas where good line and grade require deep cuts, particularly on side hills. Talus deposits deeper than 15 ft were the greatest source of slides, especially where they contained ground water, as was usually the case.

Slide areas were treated by removing major portions of the upland soil load, by benching the soil faces, by exposing surfaces of bed rock, and by

Below: At site of Bluestone River Bridge, 50-ft vertical cliff and 45-deg ground slopes added to difficulties of surveying and other work. Piers were poured by pumping from central mixing plant shown just to right of piers on far side of gorge. Footbridge below carried Pumpcrete pipe to piers on near side. Lewis & Bowman, Inc., was contractor on work here shown as of June 1953.

Below: Forms for top of Pier 2, Bluestone River Bridge, are being set. Completed deck will be 268 ft above normal water level. **Below right:** View of bridge in December 1953 shows American Bridge Division of U.S. Steel Corp. advancing erection of south end of superstructure towards Pier 3. Steel erection is now nearing completion. Principal members in trusses are rolled-beam sections, selected to make maintenance easier.





installing perforated drains for the relief of ground-water pressures. The volume of slide material removed was in excess of 2,000,000 cu yd, or 7 percent of the total excavation for the project. And the scarred excavation slopes, where the natural balance of forces acting on these hillside soils has been disturbed, are yet to be put to the test of prolonged periods of wet weather.

Two-lane tunnel in rock

Discussion of this project would be incomplete without a brief description of the largest single structure, the Memorial Tunnel near Standard. Approximately a half mile long, it is a solid-rock bore through sandstones and shales. It will be fully lined with concrete, finished with wall tile, and ventilated and illuminated to high standards.

At the south portal, the tunnel enters a ridge about 300 ft above the adjacent valley, and emerges at the north portal on a line with a deep draw, but 60 ft below the bed of this draw, which originally formed the bed of a stream. An elaborate concrete drainage system had to be constructed to intercept all the surface waters and carry them around the portal. Because of this topography, the rock back slopes, carefully benched for protection against weathering, tower more than 250 ft above this north portal of the tunnel. Weep drains protect the portal retaining walls from ground-water damage.

The tunnel roadway will have a full width of 24 ft from curb to curb and there will be an emergency sidewalk on one side. Special carbon dioxide analyzers will be directly connected to an alarm system in the service building so that satisfactory air conditions in the tunnel can be maintained at a minimum cost for the operation of ventilating equipment.

Four contracts have been awarded for the construction of the tunnel and associated buildings and equipment. By about January 15, two-thirds of the concrete lining was in place, the work proceeding on a round-the-clock schedule with one pour a day. Excellent progress is also being made on the service and ventilation buildings. The ventilation machinery has undergone acceptance tests and is ready for shipment. Tile lining and paving operations in the tunnel will be started in February.

Construction activities on the turnpike have now reached the end of the first full construction season, and progress can be reported as generally very satisfactory. Twenty contracts for combined grading, drainage, bridge substructures, relocation and paving of marginal roads, and channel relocations are completed or nearing completion by 16 contracting firms. These contractors have excavated over 26,500,000 cu yd of material which was over 60 percent rock, and have placed 83,000 cu yd of concrete. Approximately 3,500,000 cu yd of earth work and 11,000 cu yd of concrete remain to be placed before the spring of 1954.

Three separate contracts awarded for the three major bridge substructures are now essentially complete. Steel fabrication for these bridges was divided between two major fabricators and the steel is being erected by one of them. All structural steel fabrication is essentially completed, and over 40 percent of the total tonnage is erected. No work has been started on the decks for the three major bridges since steel erection is incomplete on these structures.

Top photo: In slide area along Kanawha River, 6 miles south of Charleston, subcontractor Nello L. Teer Co. is hauling and compacting fill. Here also some transmission towers required relocation. **Directly above:** Cuts through water-bearing talus slopes too frequently caused slides. Usual treatment involved removal of all upslope soil load down to rock. Removal of slide material increased excavation upward of 2 million cu yd—about 7 percent of estimated quantities. This slide is about 7 miles south of Charleston. Slopes are now being seeded and mulched by turnpike maintenance crews using water-borne application of seed and fertilizer and combination chopper-blower to apply mulch.

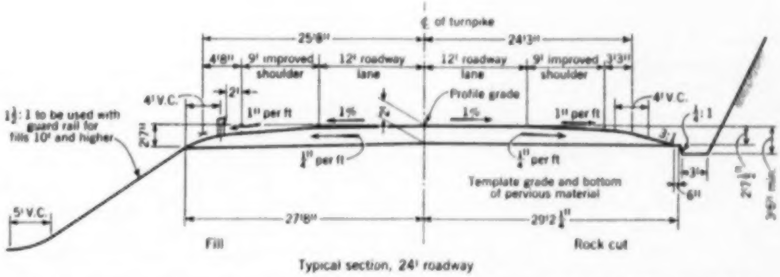


FIG. 2. Typical roadway cross section is shown half in rock cut and half in fill. Extra 12 ft of pavement width is added wherever profile is such as to slow trucks appreciably below normal 60-mph design speed.

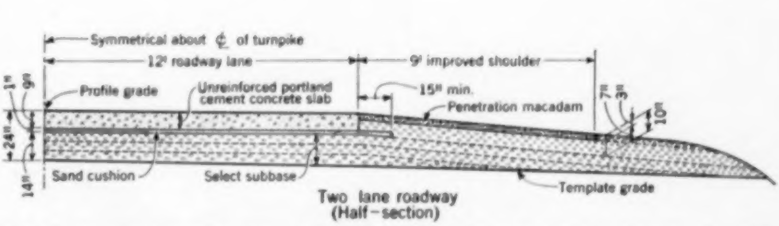
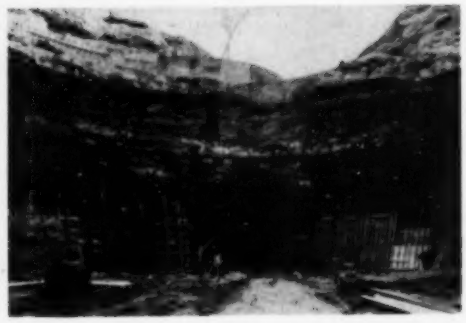


FIG. 3. Pavement consists of unreinforced concrete slab 9 in. thick and 24 ft wide, with sawn transverse joints at 18-ft spacing, laid on sand cushion over 14 in. of rolled crushed sandstone base. Penetration macadam shoulders are each 9 ft wide, 3 in. thick, on sandstone base.

Fourmile Fork Bridge, similar in design to Bluestone River Bridge, adjoins south portal of Memorial Tunnel near Mile 66. This view shows status on September 1, 1953. Erection of steel is now nearly complete. From abutment to abutment, bridge is about one-quarter mile long and central span close to 504 ft. Maximum height of deck above gorge is 285 ft.



North portal of Memorial Tunnel, at top of 3.25-percent tunnel grade, emerges at an elevation 60 ft below bed of former watercourse. Surface water is carried around portal by elaborate concrete drainage system. Rock back-slopes, towering 250 ft above turnpike grade, were benched against weathering. Close to 400,000 cu yd was excavated from this approach cut by as many as three $2^1/_2$-cu yd shovels operating on two 10-hour shifts, six days a week.

Concrete bridge decks have been awarded to three contractors, and the deck slabs have been poured on 19 of the 73 minor bridges on the project.

Paving work is divided into four contracts. Pavement, Figs. 2 and 3, is to be a 9-in. unreinforced portland cement concrete slab, with sawn joints on 18-ft centers, placed on a 1-in. sand cushion on top of a 14-in. subbase of crushed sandstone. The price of paving slab averages \$5.25 per sq yd. Stone for the subbase is now being produced at five quarry sites near the turnpike alignment, and two additional quarry sites are being set up.

Miscellaneous contracts have been awarded for toll booths and collection equipment, guard rail, utility buildings at toll plazas, service buildings, and area lighting.

Anticipated schedule

It is anticipated that the remainder of the winter season will be utilized as fully as the weather permits in completing grading, substructures,

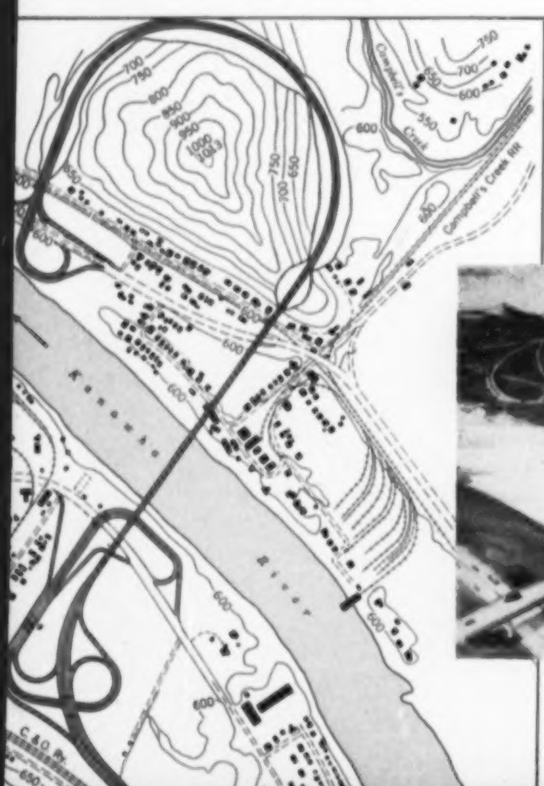
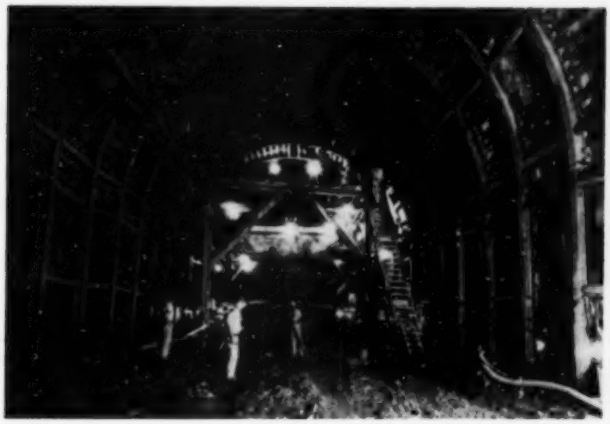


FIG. 4. Two interchanges, with toll booths, at northern end of turnpike, serve Charleston metropolitan area. Rugged topography was overcome with 2,166-ft bridge over Kanawha River and 700,000 cu yd of cut. Each interchange connects with a four-lane divided boulevard, providing easy access to Charleston 3 miles away and to its airport 6 miles distant, in one of world's busiest chemical manufacturing areas. Highways to west connect with Huntington and Cincinnati, to north, with Parkersburg, Chicago, Wheeling, and Pittsburgh.

Kanawha River Bridge, seen in sketch at left, is nearly $^1/_2$ mile long, longest on route. Below, Maxon Construction Co., Inc., is seen pouring final monolith on east pier in Sept. 1953. At present, foundations are essentially complete and steel erection well advanced.



Memorial Tunnel, 30 ft high by 33 ft wide and 1/2 mile long, is two-lane hole driven through rock by Bates and Rogers Construction Co. from south or Fourmile Fork end. Three-platform steel jumbo mounted on four crawlers was maneuvered to and from drill face by tractor. To dispose of muck, 2-yd shovel with 24-ft boom loaded string of four Tournarockers. From 90 to 140 drill holes, patterned to suit spacing of H-section steel sets, pulled 8 to 12 ft per round. Tunnel was holed through September 30, 1953.

Memorial Tunnel is lined throughout with concrete, placed by traveling pump unit shown in top view starting lining at south portal. Agitator trucks hauled concrete from contractor's mixing plant on nearby railroad siding, seen directly above. Concreting will be completed about March 1, 1954. Finished tunnel will be tiled, fully ventilated, and lighted.

steel erection for bridges, bridge decks, and tunnel construction, the latter being only slightly affected by weather conditions. Paving contractors will create huge stockpiles of subbase material in order to have them ready for rapid placement as soon as spring weather arrives.

Engineers will find no respite during the winter. Final computations and estimates for grading contracts that have been completed will take many hours of indoor work, away from the rigors of the mountain winter. Other engineers will be engaged in planning and preparing contracts for miscellaneous items such as signs, delineators, striping, communications, and maintenance buildings and equipment. Others less fortunate will be called upon to make final inspections and do final cross-sectioning, invigorating occupations in below-freezing temperatures with the wind funneling in the hollows.

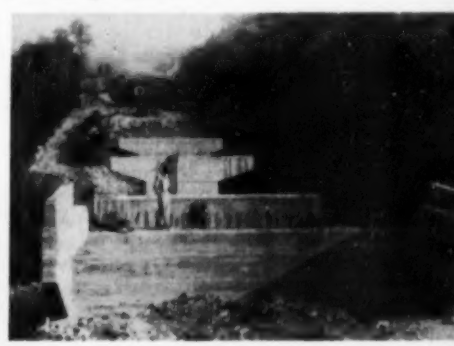
Opening of this $133,000,000 turnpike is scheduled for August 1, 1954. This will require the placing of 1,571,870 sq yd of pavement in 100 working days, starting about April 1. At least eleven 34E dual-drum pavers and allied equipment will be utilized. The spring program is now being thoroughly planned and carefully reviewed to give assurance of meeting the exacting schedules that have been established. (See Fig. 5.)

Work has now progressed to the point where the ultimate facility can be visualized under operating conditions. Clearly it will be a scenic route rivaling in beauty many that have been constructed exclusively for scenic purposes. At the same time it will be a functional traffic artery permitting the movement of heavy volumes of freight and passenger traffic through an area formerly considered impassable. In fact this area had achieved the dubious distinction of being considered the principal physical barrier to traffic movement from the Great Lakes to the Carolinas. In times past it had been bypassed in favor of longer routes with less difficult terrain.

D. Holmes Morton of Charleston is chairman of the West Virginia Turnpike Commission and William G. Stathers is vice-chairman. Other members of the Commission are Edward J. Flaccus of Wheeling, Hugh F. Hutchinson of Lewisburg and H.

Reinforced concrete arch culvert of 10-ft diameter is being cast to carry drainage under turnpike fill near Mossey interchange. Cost of drainage structures averages $75,000 per mile, including farmers' access culverts.

Small bridges generally have continuous rolled-beam deck resting on single pedestal piers carried to rock. Abutments often rest on compacted fill. This bridge, typical of 73 minor structures, spans spur of C. & O. Railroad near Mile 32, south of Beckley. Bridge substructures for this section, and grading operations beyond bridge, are by Latrobe Construction Co. AASHO 1949 specifications governed Turnpike bridge design for H20-S16 loadings. Approach pavement slabs are to be reinforced. Before paving operations start in spring of 1954, most bridges will be decked to facilitate hauling operations.



Estimated quantities for principal items of work

Principal Items of Work	Quantities	Principal Items of Work	Quantities
Clearing and grubbing	1,669 acres	Sawn joints	1,400,000 lin ft
Grading	30,000,000 cu yd	Guard rail	381,800 lin ft
Concrete	122,380 cu yd	Bridge decks	664,500 sq ft
Reinforcing steel	11,904,000 lb	Total bridge steel	19,000 tons
Culvert pipes and underdrains	270,550 lin ft	Tunnel excavation	91,800 cu yd
Macadam-base aggregate	86,980 tons	Minor bridges	73
Portland cement concrete pavement	1,571,870 sq yd	Major bridges	3
Emulsified asphalt	1,783,350 gal	Service areas	3
Select subbase	2,842,842 tons	Interchanges	6

Chronology of construction since start of work

West Virginia Turnpike Commission appointed	Oct. 11, 1949	Tunnel holed out	Sept. 30, 1953
Traffic studies started	April 1950	Pavement contracts awarded	Oct. 9, 1953
Location and cost studies started	May 3, 1950	First bridge deck poured	Nov. 6, 1953
Feasibility determined	Nov. 1, 1951	Guard-rail contract awarded	Nov. 10, 1953
Series A bonds sold	Apr. 10, 1952	Last toll collection contract awarded	Nov. 10, 1953
Final design started	Apr. 24, 1952	First pavement subbase placed	Nov. 16, 1953
Ground broken	Aug. 29, 1952	Scheduled start of paving	Apr. 1, 1954
Last grading and bridge substructure contract awarded	July 2, 1953	Scheduled completion of bridge steel erection	Apr. 15, 1954
First bridge substructure completed	Aug. 11, 1953	Turnpike scheduled to open to traffic	Aug. 1, 1954
First bridge superstructure erected and riveted	Aug. 21, 1953		

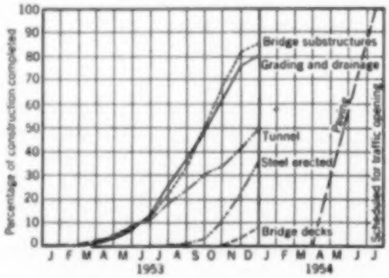


FIG. 5. Progress chart of construction shows that, while ground was broken in August 1952, grading got under way in March 1953, and was 83 percent completed by end of 1953. Paving—dashed line—is expected to begin about April 1 and be completed 100 days later in time for August 1 opening of Turnpike.

K. Griffith, A.M. ASCE, ex-officio, State Road Commissioner. The former governor of West Virginia, and an early proponent of the facility, Okey L. Patteson, has recently been appointed general manager. Ray Cavendish, M.ASCE, serves as chief engineer, and Allen C. Kinnaman as secretary-treasurer. Lee M. Kenna is general counsel.

Coverdale and Colpitts made the traffic and revenue studies, and Howard, Needles, Tammen & Bergendoff made the location and carried out the studies preceding financing.

Final design and supervision of construction are by Howard, Needles, Tammen & Bergendoff as general consultants, designers of all bridges and in charge of supervision of construction of the three major bridges and the tunnel. Elmer Timby, M.ASCE, is managing partner on the project for the general consultants.

A. Gordon Lorimer is the consulting architect. Singstad & Baillie are the designers of the tunnel. Capitol Engineering Corporation are the designers of Miles 0 to 20; Fay, Spofford & Thorndike of Miles 20 to 49, and supervisors of construction of Miles 0 to 49; Gannett Fleming Corddry & Carpenter, Inc., are designers and supervisors of construction for Miles 49 to 88. Greife & Daley are the architects for the service buildings.

Contractors for grading, drainage, and minor bridge substructures, with quantities and amounts

Mile Location	Contractor	Grading, Cu Yd	Total Contract
0– 4.8	Nello L. Teer Co.	903,300	$ 699,493
4.8– 9.0	W. E. Graham & Sons	1,048,000	1,117,463
9.0–11.0	C. E. Wetherall Co.	232,000	391,638
11.0–14.0	Ralph E. Mills Co.	1,559,341	1,438,765
14.0–20.0	Condon-Cunningham Co. Peter Kiewit Sons' Co.	2,512,000	3,499,417
20.0–25.0	Oman Construction Co.	720,500	1,258,603
25.0–32.0	Central Penn. Quarry & Stripping Co.	1,650,000	2,309,767
32.0–41.0	Latrobe Road Const. Co.	2,017,000	3,109,839
41.0–46.0	Clark-Ferrel Co. H. N. Rodgers & Sons Co.	1,116,006	2,070,133
46.0–51.6	W. W. Holt & Sons	1,330,000	2,394,075

Mile Location	Contractor	Grading, Cu Yd	Total Contract
51.6–57.6	S. J. Groves & Sons Co.	2,832,000	5,864,541
57.9–68.0	Groves, Lundin & Cox, Inc.	2,127,000	3,917,738
68.3–71.3	Nello L. Teer Co.	1,610,000	2,952,436
71.3–80.3	Ralph E. Mills Co. Morrison-Knudsen Co., Inc.	3,260,000	6,184,347
80.3–81.7	L. S. Coleman & Co.	540,000	700,073
81.7–83.4	Boso & Ritchie, Inc. All by Nello L. Teer Co. as subcontractor	1,749,050	1,059,750
83.4–85.9	Boso & Ritchie, Inc.	447,390	689,297
85.9–87.0	Suber & Co., Inc. R. G. Foster & Co.	1,584,500	1,584,460
87.4–88.0	Standard Asphalt & Tar Co.	615,500	986,977

Bridge, tunnel, and paving contractors, with contract amounts

Location	Contractor	Amount
Kanawha River Bridge substructure	Maxon Constr. Co., Inc.	$ 560,430
Fourmile Fork Bridge substructure	Bates & Rogers Constr. Co.	257,909
Bluestone River Bridge substructure	Lewis & Bowman, Inc.	248,130
Minor bridge decks	Lewis & Bowman, Inc.	912,775
Minor bridge decks	C. F. Rule Constr. Co.	1,472,840
Steel bridge superstructures	American Bridge Division of U.S. Steel Corp. and Bethlehem Steel Co.	9,523,006

Location	Contractor	Amount
Memorial Tunnel	Bates & Rogers Constr. Co.	2,858,043
	Kuhn Construction Co.	700,864
	American Blower Corp.	88,792
	Jandous Electric Construction Co.	353,400
Paving:		
Mile 0–20	J. B. Michael & Co., Inc.	4,386,690
Mile 20–51.6	Nello L. Teer Co.	6,951,177
Mile 51.6–68	Bero Engineering & Constr. Co.	3,418,323
Mile 68.3–88	R. B. Tyler Co. and Breslin Constr. Co.	4,753,569

Density currents studied in glass-walled flume

DONALD R. F. HARLEMAN, J.M. ASCE

Assistant Professor of Hydraulics, Hydrodynamics Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

Fifth in a series sponsored by the Fluid Dynamics Committee of ASCE's Engineering Mechanics Division

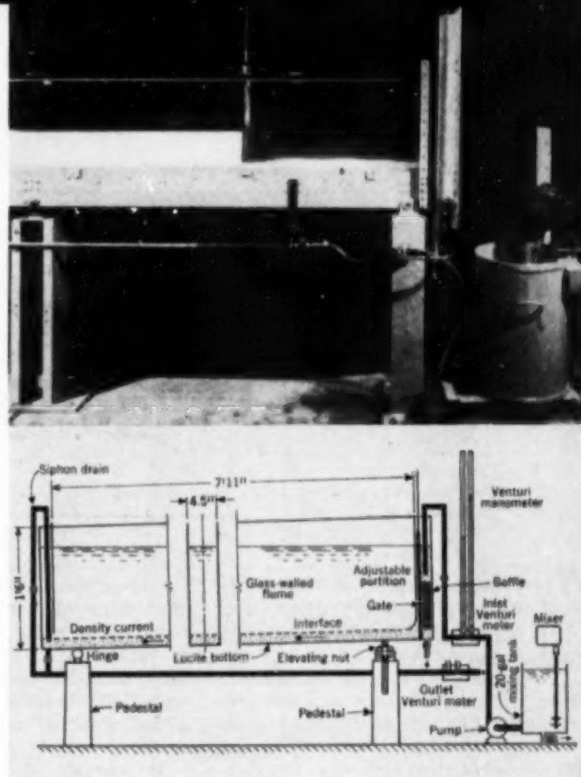


FIG. 1. Flume demonstrates many types of density-current phenomena, such as sluice-gate discharge of a dense liquid here shown. Bottom of flume is lucite strip (lighted by fluorescent tubes below) set at same elevation as supporting channel to give unobstructed view along bottom of flume through glass side walls.

The density current flume in the MIT Hydrodynamics Laboratory has been successfully used both for basic research in the mechanics of stratified flows and for student demonstrations and experiments. A density current may be described as a gravity flow of a fluid through another fluid of slightly different density. Several common occurrences of this phenomenon are found in hydraulic engineering, among them currents produced in reservoirs under the action of density differences caused by suspended silt or temperature variations, and currents found in tidal estuaries where stratifications of fresh and salt water are present.

The MIT experimental equipment (Fig. 1) consists of two parallel sections of plate glass 8 ft long and 18 in. high, supported by an aluminum channel and angles forming a flume $4^1/_2$ in. wide. The supply system consists of a 20-gal reservoir with a mechanical mixer and a small centrifugal pump having a rated discharge of 2 gal per min under a head of 7 ft. The pump discharge passes through the inlet Venturi meter ($^5/_{16}$ in. $\times$ $^1/_2$ in.) and thence into the entrance chamber of the flume.

At the beginning of a test an adjustable gate separating the entrance chamber from the main channel is lowered, the channel is filled with tap water, which is allowed to come to rest. The density current is formed by raising the gate when the level of the dense liquid in the entrance chamber is the same as that of the channel. When the head of the density current has reached the downstream end of the flume, the drain valves are opened and the discharge passing through the outlet Venturi meter is equalized with the inflow rate. If the flume is set to a positive slope, conditions of uniform flow can be observed for various discharges. By means of an elevating nut and a 1-in. threaded spindle, slopes up to 20 percent can be obtained. Currents caused by density differences as small as 0.2 percent can readily be observed. Both Bentonite clay suspensions and sodium chloride solutions have been used to obtain the desired density differences.

The low velocities of the order of 1 in. per second associated with this type of flow require special techniques of measurement, and afford an opportunity for new developments. The method of falling drops has been found satisfactory, and reliable results can be obtained even by inexperienced observers. A mixture of zylene and butyl-phthalate dyed with eosin is adjusted so that small drops injected with a hypodermic syringe will fall slowly through both the upper and lower liquids. The displacement curve of the drop is traced on a transparent grid on the side wall. For small increments of the curve, Δy and Δx are measured. In addition, the fall velocity V_y is obtained by means of a stop watch, while the drop is falling vertically in the upper liquid. The x component of velocity for this increment of the curve is therefore $V_x = V_y (\Delta x/\Delta y)$.

For precise work, a motion picture record of the displacement may be used, the time interval being obtained from the frame speed of the camera. The initiation of turbulence can be demonstrated by slowly increasing the rate of flow of the dense liquid. It will be found that the interface will become covered with waves and that an increase in the discharge will result in the breaking of these waves and the generation of eddies in this region. The extent of the mixing region will be apparent from the gradual coloring of the upper fluid by the lower current.

The flume can be adapted to demonstrate many other types of density current phenomena, such as the sluice-gate discharge of a dense liquid as shown in the photograph. Surges and backwater profiles can be obtained at the interface by increasing or decreasing the flow rate. Other possibilities include flow over weirs and spillways; in fact, almost any free surface phenomenon has its counterpart in subsurface flow with the observational advantage of greatly reduced velocities and gravitational effects.

Cost index developed by California Division of Highways proves its value

When prices began climbing upward in the inflationary spiral after World War II, the expanded highway program aimed at correction of existing deficiencies of the California State Highway System was not progressing at the rate anticipated under increased revenue. It then became more evident than ever that the California Division of Highways had need for basic information on trends of highway construction costs. Under the direction of the writer as Assistant State Highway Engineer, Administration, an extensive study was inaugurated in 1948 by departmental engineers to find a simple and reliable method for determining relative costs over a period of time.

Other indexes studied

Preliminary investigations into the subject indicated that some form of cost index would be the best and most convenient means for determining the annual fluctuations in costs by relating them to a common base. Studies were made of the several available commodity-price or cost indexes, including that of the Bureau of Labor Statistics of the U.S. Department of Labor, the U. S. Construction Cost Index of *Engineering News-Record*, and the Composite Mile Index of the U.S. Bureau of Public Roads. Conclusions drawn from these studies were to the effect that, in some instances, the methods used in the development of the several indexes lacked the simplicity which the department was seeking, largely because of inclusion in the basic formulas of too many items and because of numerous adjustments for intangible or indefinite factors.

To eliminate the necessity for assumptions and adjustments for the intangible factors, it was decided to follow the lead of the U.S. Bureau of Public Roads' Composite Mile Index and base the California Highway Construction Cost Index on the factual data of actual low-bid prices received on state highway contracts. It was realized that the intangibles are reflected in contractors' bid prices and that these prices represent the actual cost of construction to the state.

It was also determined that fluctuation in prices of other than major items paralleled to some degree the changes in the cost of the principal items of construction. On this basis then, and to secure maximum simplicity in the computation of our index, the number of major items selected for use in developing it was reduced to those eight found to have the greatest influence on the cost of California state highway and bridge contracts.

These eight items are:

1. Roadway excavation
2. Untreated rock base (or crusher-run base)
3. Plant-mixed surfacing
4. Asphalt concrete pavement
5. Portland cement concrete pavement
6. Portland cement concrete structures
7. Bar reinforcing steel
8. Structural steel

After nearly five years of use, the California index has been found to be the practical answer to the need for basic information on fluctuations in highway construction costs in California. The index meets the specifications laid down at the start of the studies in that it is simple to develop, involving only eight items; the formula for its computation includes a minimum of refinements; and its results are a reliable indicator of the trends in highway construction costs.

Based on actual contract prices

Since the Division of Highways was primarily interested in the fluctuations of cost to the state for highway construction, the investigators based the index entirely on actual contract prices. Under this factual method of approach, it may not be possible to put a finger on the more obscure factors such as equipment costs, allowances for delays in the delivery of materials, or labor productivity, but since these items are in the bid prices they are accounted for in the index.

Following the methods employed by the U. S. Bureau of Labor Statistics, probably the best authority on developing price indexes, the California index was calculated fundamentally from an adaptation of the Laspeyres formula, which is expressed as:

$$I = \frac{\Sigma P_t\ Q_o}{\Sigma P_o\ Q_o} \times 100$$

in which

P_t = cost in the current period
P_o = cost in the base period
Q_o = quantity weight in the base period

Other authorities agree that this is the most practical formula for determining satisfactory indexes of comparative price levels, provided the interval between the current period and the base is not too great. The Bureau of Labor Statistics considers about 20 years to be the maximum for this interval.

The year 1949 was selected as the base year (with the index number of 100) on the assumption that it represents conditions before the beginning of the national defense programs, which caused the rise in construction costs.

The eight major contract items previously listed were selected as representative of the majority of work on state highway contracts. To give proper weight to each of these items, the total quantity of each for the fiscal year from July 1, 1947, to

RICHARD H. WILSON, A.M. ASCE

Assistant State Highway Engineer

(Administration)

California Division of Highways

Sacramento, Calif.

June 30, 1948, was compiled as follows:

No.	Item	Base Quantity
1.	Roadway excavation	15,697,410 cu yd
2.	Crusher-run base (untreated rock base)	681,611 tons
3.	Plant-mixed surfacing	1,501,178 tons
4.	Asphalt concrete	34,060 tons
5.	Portland cement concrete pavement	209,157 cu yd
6.	Class "A" portland cement concrete (structures)	163,760 cu yd
7.	Bar reinforcing steel	27,305,435 lb
8.	Structural steel	36,413,500 lb

The average bid prices for these items were weighted by determining the total quantity and total cost of each item in each year from 1940 to 1948, and the average weighted bid price determined.

The average weighted bid price for each of the eight items was then multiplied by the total base quantity of that item in order to determine the index number for each period. Originally full-year periods were established for 1940 to 1945 and for each half year to June 30, 1948. In later computations of the index these have been adjusted to full years through 1949, and for each quarter for 1950, 1951, 1952, and 1953. These compilations give a comparative cost to the state for the same work in each period since 1940.

Compared with other indexes

For comparative purposes the California Highway Construction Cost Index, U. S. Bureau of Public Roads Composite Mile Index, and the *Engineering News-Record* U.S. Construction Cost Index, adjusted to the 1940 = 100 base, have been plotted on one chart, Fig. 1.

The Bureau of Public Roads index, adjusted for increased design requirements, is based on actual contract prices paid in the United States as a

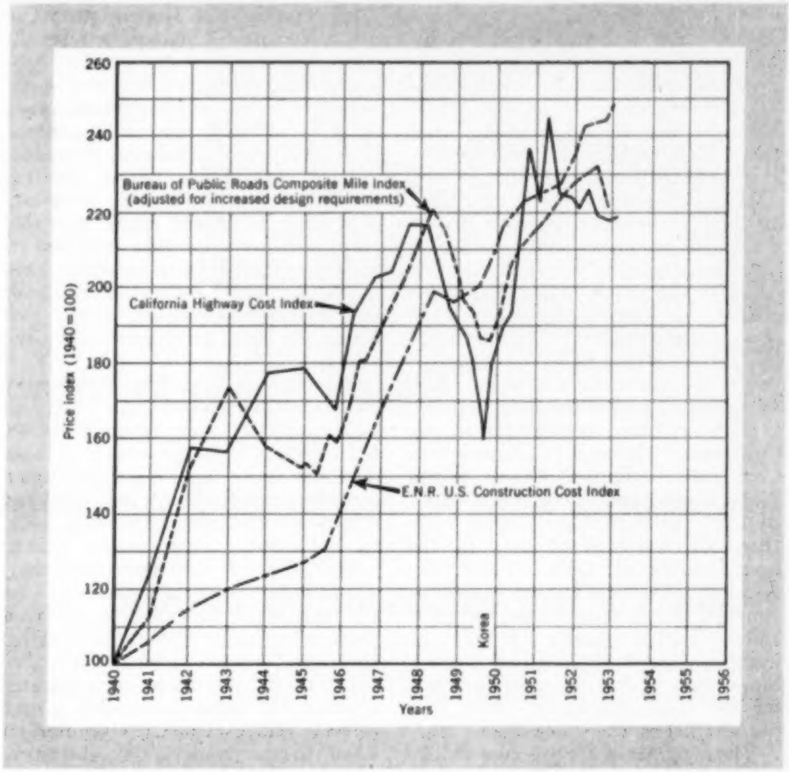


FIG. 1. California Highway Cost Index is compared with Bureau of Public Roads Composite Mile Index and *Engineering News-Record's* U. S. Construction Cost Index.

TABLE I. Average contract prices, California Division of Highways

	Roadway Excavation, per cu yd	Crusher Run Base, per ton	Plant-Mix Surfacing, per ton	Asphalt Concrete Pavement, per ton	PCC† Pavement, per cu yd	PCC† Structures, per cu yd	Bar Reinforcing Steel, per lb	Structural Steel, per lb
1940	$0.22	$1.54	$2.19	$2.97	$ 7.68	$18.33	$0.040	$0.083
1941	0.26	2.31	2.84	3.18	7.54	23.31	0.053	0.107
1942	0.35	2.81	4.02	4.16	9.62	29.48	0.073	0.103
1943	0.42	2.26	3.71	4.76	11.48	31.76	0.059	0.080
1944	0.50	2.45	4.10	4.50	10.46	31.99	0.054	0.132
1945	0.51	2.42	4.20	4.88	10.90	37.20	0.059	0.102
1946	0.41	2.45	4.00	4.68	9.48	37.38	0.060	0.099
1947	0.46	2.42	4.32	5.38	12.38	48.44	0.080	0.138
1948	0.55	2.43	4.30	5.38	13.04	49.86	0.092	0.126
1949	0.49	2.67	4.67	4.64	12.28	48.67	0.096	0.117
1950:								
1st quarter	0.34	2.22	3.65	3.74	....	40.15	0.077	0.081
2nd quarter	0.40	2.13	4.48	3.74	10.86	43.03	0.080	0.105
3rd quarter	0.41	2.32	4.25	5.50	10.91	44.34	0.093	0.131
4th quarter	0.42	2.81	4.64	4.61	12.55	43.18	0.098	0.120
1951:								
1st quarter	0.45	3.07	4.06	5.22	11.71	46.38	0.103	0.206
2nd quarter	0.63	3.88	4.56	4.63	12.93	51.50	0.105	0.166
3rd quarter	0.56	2.88	4.59	3.90	12.41	46.14	0.107	0.165
4th quarter	0.66	2.91	5.66	4.89	12.71	49.38	0.105	0.160
1952:								
1st quarter	0.56	3.25	4.88	4.77	14.25	47.46	0.094	0.152
2nd quarter	0.53	3.19	5.29	4.13	14.20	49.12	0.091	0.143
3rd quarter	0.55	2.61	5.49	4.60	12.80	48.21	0.094	0.132
4th quarter	0.66	2.68	4.97	...	12.53	48.45	0.094	0.128
1953:								
1st quarter	0.45	2.48*	5.27	4.46	12.47	53.19	0.098	0.150
2nd quarter	0.50	2.07	5.38	4.59	13.06	52.68	0.091	0.132
3rd quarter	0.54	2.15	5.30	4.82	13.78	49.23	0.092	0.129

* Untreated rock base substituted for crusher-run base at this point.
† Portland-cement concrete.

whole for the construction of a hypothetical mile of composite highway. Having a factual foundation, it follows the California index within relatively close limits. The differences are accounted for by differences between local costs in California and the average of costs over the entire nation.

The *ENR* index is based on a fixed amount of materials and hours of labor and, according to the editors of that magazine, is not adjusted for labor productivity, materials availability, or other intangibles. Although at present it is higher, the *ENR* index generally tends to be lower than the California or BPR indexes, which are based on actual over-all costs.

Highway costs, as measured by the California Highway Construction Cost Index, climbed during World War II and the postwar period to a peak of 216.6 in 1948. After 1948 there was a decline to 160.0 by the first quarter of 1950. From this point on, there was a very rapid rise through the second quarter of 1951. In the fourth quarter of 1951 the index reached its highest point, 245.4. Since then it has dropped to 218.0 for the third quarter of 1953, 11.2 percent below the 245.4 high.

These fluctuations are now chiefly of historical interest. Through them the analyst may trace the effect of national and international factors on the general economy. The steady rise from 1940 to 1945 marked the period of wartime activity with its accompanying industrial boom which was carried over through 1948 in the "catching-up" period.

Then came the rapid decline of the index through the first quarter of 1950 as the international outlook appeared to calm a little. There was more competition for jobs, labor productivity increased, and material prices were decreasing for the first time since 1940. Materials became definitely available at guaranteed prices.

Then came the Korean situation. The nation was in the throes of a national defense program with federal control of critical materials, and the old uncertainties again prevailed. Scarcity of materials, whether real or synthetic, started another price rise. The Air Force, the Army and the Navy announced national defense construction programs amounting to 6 billion dollars, with planned expenditures in California placed at $467,000,000. The result was an upward surge in costs, the California Construction Cost Index reaching 238.3 in the second quarter of 1951 and 245.4 in the fourth quarter, a rise of 53.4 percent in 21 months.

However, as the Korean situation eased, control of materials relaxed, prices settled, and competition between bidders on state highway work increased. One factor which particularly affected bidding on heavy construction in California was the governmental freeze placed on the 6-billion-dollar expansion program of the Air Force, the Army, and the Navy. Some California contractors who were low bidders on large contracts for such federal work now find themselves waiting while the whole program is reviewed and revamped.

There are a large number of construction contractors operating in California (691 are prequalified to bid on state highway work). Many of these firms must regularly meet large equipment obligations and, in addition, must have continuing work to hold their organizations intact, with the result that currently they are bidding low to get the jobs. In all probability these influences have been determining factors in bringing the index down. However, it is difficult to see anything except rising costs in the future. Another round of wage increases recently granted to labor in the construction industry, coupled with similar hikes in manufacturing, can be met only by increases in the prices of items going into construction projects.

While the cost index itself does not provide a tool for projecting trends into the future, it is of great assistance in analyzing what has happened, if for no other reason than that it poses the question "Why?" "Why did this rise or drop occur in such and such a quarter?" To answer this question, a study of various factors which might possibly affect construction costs is required, and with each study a better insight is obtained into the influences concerned.

The index is found to be of great value in keeping cost estimates up to date, and its ready computation makes it available for circulation throughout the Division of Highways' Headquarters and District offices the second or third day of each quarter. Table I gives average contract prices for the Division through the third quarter of 1953.

We in the California Division of Highways feel that the Highway Construction Cost Index fills our needs in supplying a practical tool, based on actual costs to the state, which is convenient and simple in computation.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

In the course of draining 400 acres of land at Central Lafayette near Arroy, P.R., a 7-in. rain caused a reinforced-concrete pump pit, built in a very swampy area, to float out of alignment. As the torrential rain continued, it filled the pit with water and caused it to settle again. How would you have realigned the pit? For solution, see page 95.

Editor's Note: This is the 21st in a series which started in the February 1952 issue of Civil Engineering. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it?
H.J.G.

The above problem was submitted by Wilbur E. Land, A.M.ASCE, Ft. Belvoir, Va.

Workmen tighten Dresser Style 38 coupling to tie together sections of coated and wrapped steel transmission main. Original wrapping has been further covered with a layer of glass fiber mat and a layer of 15-lb tar-saturated asbestos felt.

Construction program of Philadelphia Suburban Water Company meets unprecedented demand

FRANCIS S. FRIEL, M. ASCE, President, Albright & Friel, Inc., Consulting Engineers, Philadelphia, Pa.

Because of its foresight in installing additional transmission, water storage, and distribution-system facilities in critical areas, the Philadelphia Suburban Water Co. successfully met the unprecedented demand placed on the system by the prolonged period of dry weather in the summer of 1953.

The area served by the company consists of about 300 sq miles in Montgomery, Delaware, and Chester counties surrounding the city of Philadelphia and embracing 49 municipalities. The company was originally formed by the merger of 38 different water companies whose distribution and supply facilities were interconnected to establish the consolidated water works system as it now exists.

Great increase in demand

Since 1944 the number of customers served by the company has increased from 95,244 (approximately 348,000 persons) to the present 137,800 (approximately 500,000 persons), a growth of 44.7 percent. As a result of this population growth, the water demand in the past decade has increased from 25.4 to 38.8 mgd. In the past two years the annual population increase has been accelerated beyond the average for the decade.

The peak demands of 1952 occurred during a 12-day period in June, when the average daily water use was 43.1 mgd. The send-out from the pumping stations on the peak day was 46.6 mgd. In 1953 the highest demand occurred during a 12-day period in late August and early September when the average daily use was 50.3 mgd, and the send-out from the pumping stations on the peak day was 56.0 mgd. These unparalleled peak demands were met during the dry period of 1953 because of the construction program completed by the company during the first six months of the year.

The water supply is at present secured from five sources: Neshaminy Creek, Pennypack Creek, Perkiomen Creek, Pickering Creek, and Crum Creek. To meet the immediate peak demands, additional pumping, transmission, storage, and distribution facilities were installed. Construction expenditures during 1953 were directed toward this type of facility.

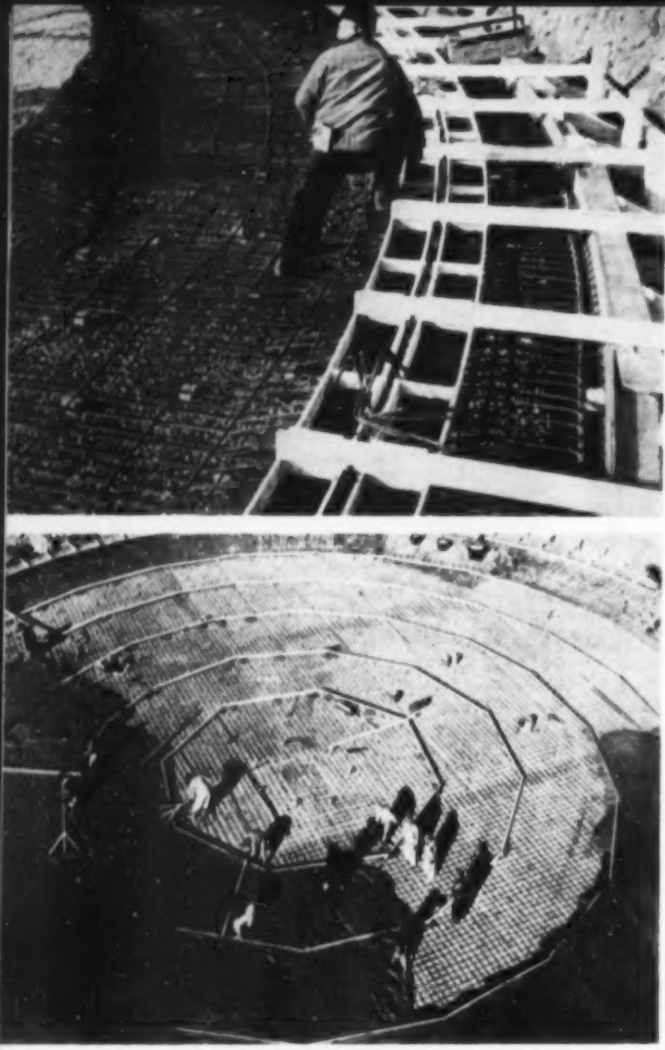
Pickering Creek Transmission Main

The three transmission mains existing prior to 1953 which conveyed water from the Pickering Creek Pumping Station to the distribution system had insufficient capacity to meet the peak demands which it was estimated would occur during the summer of 1953. An additional pipeline was required to utilize the present and estimated future capacity of the Pickering Creek works. This pipeline, called the Pickering Creek Transmission Main—of 36 and 42-in. diameter with a total length of 8.96 miles—was installed during the first six months of 1953 (Figs. 1 and 2). The lower 5.18 miles is of 36-in. diameter, and the upper 3.78 miles of 42-in. diameter.

The 42-in. diameter section of the main will also convey water pumped from the proposed Valley Forge Station. At the high end of the 42-in. line, at North Wayne, two prestressed concrete water storage tanks were constructed with a combined capacity of 10 million gal.

The 36-in. portion of the main, between Pickering Creek and the North Wayne storage tanks, was designed to carry 21 mgd when operating under a pumping head of 600 ft, and the 42-in. main was designed to carry 30 mgd.

Materials used in the construction of the transmission main were purchased by the company through competitive bidding. Bids were taken



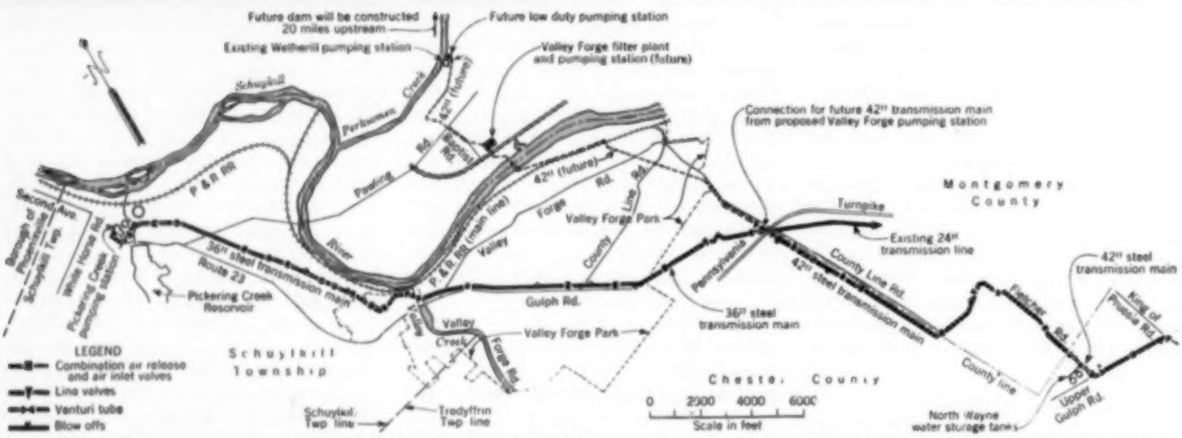
both on coated and wrapped steel pipe and on prestressed steel cylinder-type concrete pipe. The coated and wrapped steel pipe was selected because of sink-hole conditions existing in limestone areas along certain parts of the route.

This pipe was designed according to AWWA Specifications C-201 and lined and coated with enamel meeting the AWWA Specifications C-203. In addition, the outside of the pipe was wrapped with one layer of glass fiber mat together with one layer of 15-lb tar-saturated asbestos felt. The purpose of the glass fiber mat was to reinforce the tar coating to prevent damage during delivery and also to increase electrolytic resistance. The 36-in. steel pipe has a thickness of $^3/_8$ in. and the 42-in. line a thickness of $^7/_{16}$ in. In the design, the thickness was established by the collapsing resistance rather than by the water pressure. The combination diameter and thickness of the pipe is designed to safely withstand a maximum pumping pressure plus a calculated surge totaling 980 ft.

The pipe was fabricated at Steelton, Pa., 75 miles away, and delivered in trucks to the site. The 40-ft

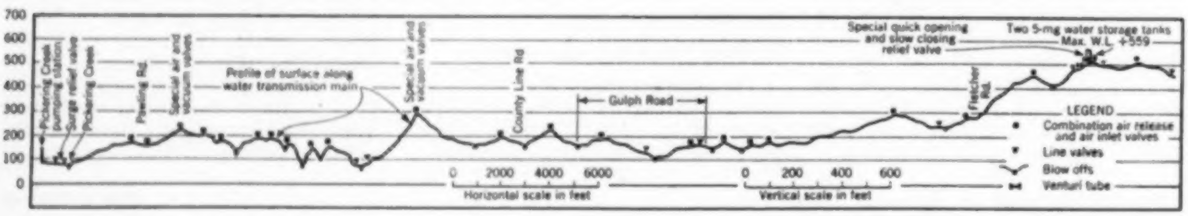
←

Keyway 21 in. wide by $2^1/_2$ in. deep (top view) is placed in wall footing to receive base of tank wall. Rubber water stop, running along center of keyway, is shown in place. Lower photo shows monolithic pouring of 540 cu yd in tank floor and wall footing.



↑ **FIG. 1. Water transmission main 8.96 miles long, installed by Philadelphia Suburban Water Co., utilizes full capacity of Pickering Creek Pumping Station. Completed in first six months of 1953, new line averted serious water shortage in August of that year.**

FIG. 2. Profile of transmission main indicates locations of combination air-release and air-inlet valves, line valves, blow-offs and Venturi tube. ↓



lengths were joined together with Dresser Style 38 couplings. The steel pipe specials required to connect the new line with the existing transmission mains were welded and joined to the old and new pipe with Dresser couplings.

Line values were installed in the transmission main at critical points. Blow-offs were provided at the low spots, and combination air-release and air-inlet valves were placed at the high points in the line (Fig. 2). Adjacent to the Pickering Creek Pumping Station, the design also provided for the installation of duplicate 4-in. surge relief valves which operate in parallel and open on the down surge. In addition to the regular air-release and air-inlet valves installed at high points along the line, there are two critical summits on which duplicate air and vacuum valves of 4-in. diameter were placed. Adjacent to the tank site, two 4-in. parallel-operated quick-opening and slow-closing relief valves were installed in the line.

Main cathodically protected

Because stray currents are present in the area, cathodic protection will be provided for the pipeline. The Dresser couplings and all pipeline appurtenances were treated with a tar coating for their protection and for insulation against stray currents. The transmission main was further protected by isolating it from all existing lines with Dresser Type 39 insulating couplings. Across the Dresser couplings, in the transmission main, the electrical continuity was assured by welding cable bonds with a current-carrying capacity approximately equal to that of the steel pipe. On the 36-in. and 42-in. pipe, two bonds were provided at each joint. Along the 8.96 miles of the main, 15 electrolytic test stations were established, one adjacent to each insulating coupling and others at strategic points, to measure the electric current carried by the main.

Competitive bids were taken for the installation of the transmission mains, the materials having been previously purchased by the company. Construction of the Pickering Creek Transmission Main was divided into three contracts, the first for the 36-in. section of the line, the second and third for the 42-in. section.

Construction started on January 6, 1953, and installation was completed on June 13, in a total elapsed time of 125 working days. The first pipe was delivered the day before the start of construction, and the final delivery was made on May 25.

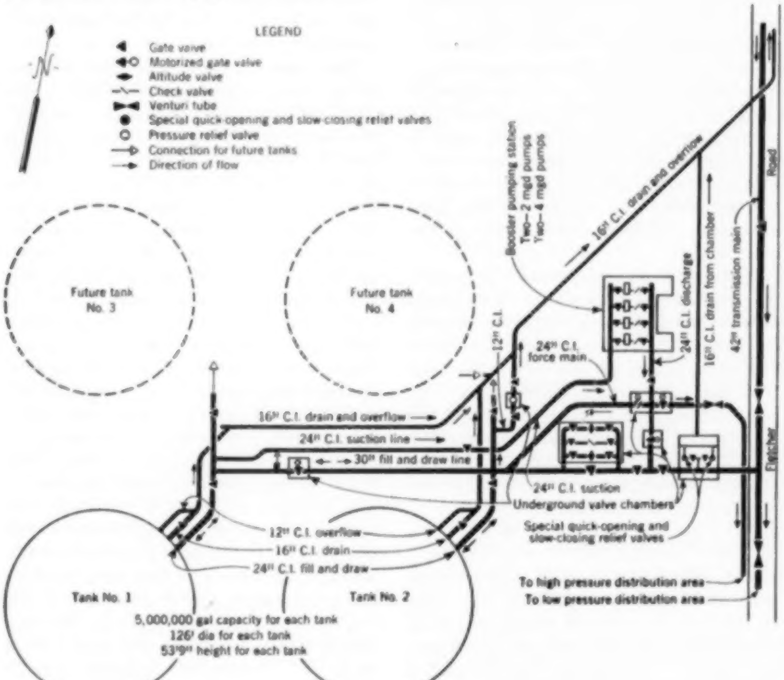
To expedite the work and to meet the deadline, the contractors were required to work 10 hours a day, 6 days a week, from the first of April to the completion of the project. The contractors employed a total of six crews on this main, and laid an average of 378 ft of pipe each day. The project included five major creek crossings and two railroad crossings.

Some difficulty was experienced in securing a tight line to meet the leakage requirements set forth in the specifications. It was necessary for the installation contractors to excavate many of the joints where the pipe was coupled together in order to locate and repair leaks. A series of pressure tests were conducted, and all the leaks that could be observed or located were repaired by tightening up the couplings. In no case did a leak develop in the pipe barrel itself.

As the main was placed in service during July, the final pressure tests had to be delayed until the peak water demand of the summer and fall had dropped off. The final test indicated that the leakage in the entire line under normal maximum operating conditions was 17 gpm without taking into account any possible leakage through the line valves. This was equivalent to 71 gal per in. diameter of pipe per mile.

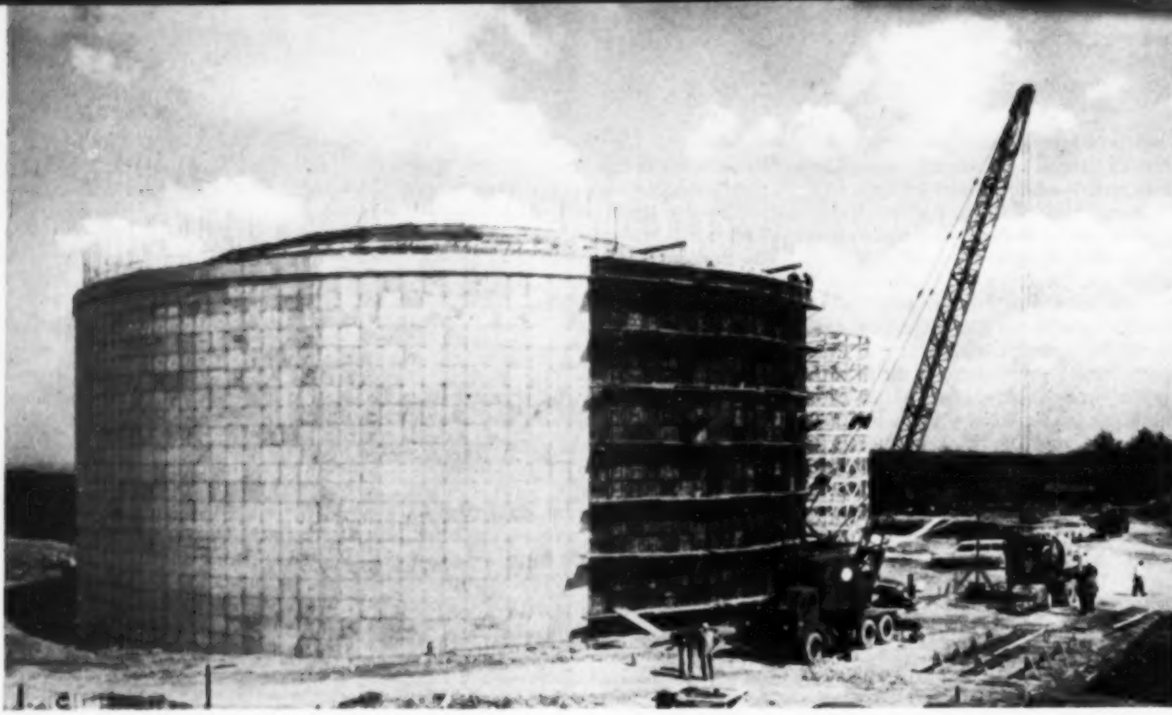
The average cost of all labor and materials for installing the 36-in. main was $36.31 per lin ft. This cost included the protective coating on the pipe, the test stations, and also all the special connections such as line valves, air-release valves, blow-offs, manholes, and other appurtenances. The average cost of the 42-in. main was $48.05 per lin ft.

FIG. 3. Two completed prestressed water tanks at North Wayne, Pa., store 5 million gal each. Tanks ride on system and are used to supply water through booster pumping station to high-pressure area.



Storage tanks and booster station

As previously mentioned, two water storage tanks were constructed at North Wayne, each with a capacity of 5 million gal. The tanks are 126 ft 0 in. in diameter and 54 ft 9 in. high. These two tanks ride on the system and also are used to supply water through the booster pumping station to a high-pressure area. See Fig. 3. The piping was designed with considerable flexibility to permit the tanks to ride on the line of either the low-pressure or the high-



Steel pans 30 in. square were used in tank wall forms. Wall was poured in segments to its full height to avoid horizontal joints. Each segment formed about one-ninth of tank's circumference. Mix of 7 bags of cement per cu yd of concrete was used to give 28-day strength of 4,500 psi.

pressure distribution system, or to permit the low-pressure distribution system to ride on the tanks and the high-pressure system to be served through the booster pumping system.

The layout is also flexible enough to permit the water from the first tank to be pumped into the second tank, and vice versa. This enables the water level to be raised, thus providing the additional head necessary to serve the low-pressure system satisfactorily during periods of peak demand. The booster station is also flexible in operation and is equipped with two 2-mgd and two 4-mgd pumping units, all automatic in operation.

Construction of tanks

Construction of the first tank began on January 2, and this tank was ready to be placed on operation on June 10, in a total elapsed time of 114 working days. Excavation for the second tank was started concurrently with that for Tank No. 1, but this tank was not completed until August 11. A strike in the construction industry in the Philadelphia area, which occurred on May 1, although it did not interfere with pipeline construction, delayed the completion of the second tank.

Foundation conditions for the tanks were excellent. The 8-in.-thick concrete slabs were placed on a 6-in. subbase of crushed stone. The slab was reinforced with $^1/_2$-in. round bars spaced 8 in. on centers in both directions. The floor of each tank, together with the foundation, contained 540 cu yd of concrete and was poured complete in one day with no construction or expansion joints. The side-wall foundation which formed a part of the floor, was 20 in. thick and approximately 13 ft wide. The maximum pressure on the footing with a full tank is 3,900 psf. A keyway $2^1/_2$ in. deep and 21 in. wide was formed in the foundation to receive the tank wall, and a continuous rubber water stop shaped in the form of a dumbbell was placed in the keyway so as to lie in the center of the core wall.

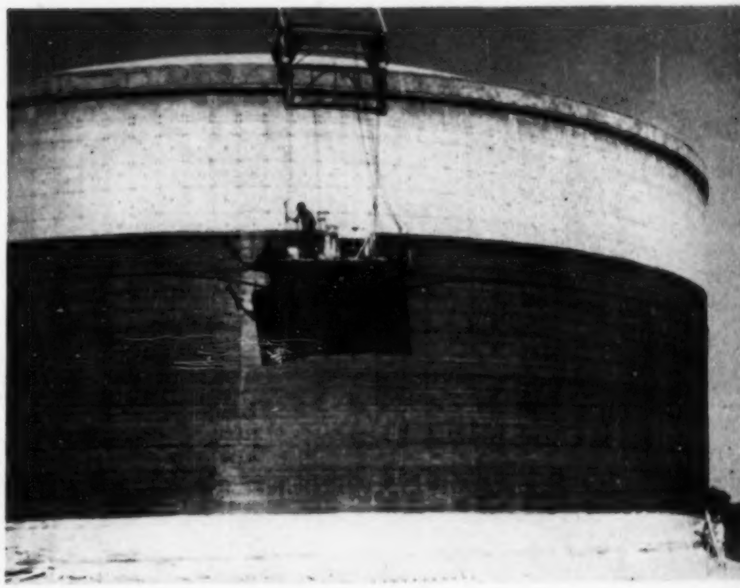
Forms for the side walls consisted of commercially available steel pans 30 in. square, which could be readily erected and dismantled. To avoid horizontal construction joints, the wall was built to its full height in one pour in segments of about one-ninth the tank's circumference. A temporary bulkhead was placed at the end of each section to permit the sections to be poured individually.

Tank walls prestressed

One hundred vertical prestressing units were required in the side walls of each tank. These units consisted of 12 wires, each 0.196 in. in diameter, pulled through a flexible metal tube so that they could be stressed after the side walls were poured. The units were hung in a true vertical position prior to their encasement in concrete, and grout tubes for each unit were extended through the inner wall forms so that the flexible tubing encasing the vertical prestressing units could be grouted from within the tank after the units had been stressed.

The side walls of the tanks were 17 in. thick and each required 1,200 cu yd of concrete. A mix of 7 bags of cement per cu yd of concrete was used to achieve the required design strength of 4,500 psi in 28 days. The side walls were poured in vertical lifts through openings left in the outer steel-pan form work. Dowels to tie in the top of the side wall with the dome of the tank were placed in the top of the wall before the concrete had set. The reinforcement for the dome consisted of wire mesh lapped at least one square and securely tied together. After the dome reinforcing was placed, the vertical prestressing operation was started. These vertical wires were stressed initially to 170,000 psi, and after stressing was completed, grout was injected through the tubes at the bottom of the wall. This grout serves to protect the wires from corrosion and it also bonds the vertical prestressing units to the side walls. The domes of the tanks were built up of pneumatic mortar. Each dome is $2^1/_2$ in. thick except at the

Pneumatic mortar is placed to form tank dome $2^1/_2$ in. thick at center. Thickness gradually increases to 10 in. at wall.



Rolling carriage places horizontal prestressing wire at minimum stress of 140,000 psi. Lower third of wall has three layers of prestressing wire, middle third two layers, and top third one layer.

outer edge, where its width is gradually increased to about 10 in. Each dome required 121 cu yd of pneumatic mortar, placed monolithically over a period of 7 days.

After the dome on a tank was completed and cured, the horizontal prestressing of the tank wall was started. This was done by a machine which applies the wire to the wall in a stressed condition. The wire winding assembly operates on a carriage which rolls around the side wall of the tank. This machine imparts the desired stress to the wire by passing it through a die of a slightly smaller diameter than that of the wire itself. The wire used was No. 8 gage, 0.162 in. in diameter, with an ultimate strength of 210,000 psi, and was applied horizontally at a minimum stress of 140,000 psi.

After the wire was in position, it was covered with a layer of pneumatic mortar to protect it against corrosion and to bond it to the concrete. The lower part of each tank received three layers of wire. This was reduced to two layers at a point about one-third of the vertical height of the tank up from the base, and it was again reduced to one layer for the upper one-third of the tank. Each inner layer of wire received a coat of mortar of at least $^1/_4$-in. thickness, and the outside layer received a coat $^5/_8$ in. thick. A total of 1,934 cu yd of concrete was used in each tank, including the floor, foundation, side wall, and the pneumatic mortar for the dome.

Because of the character of the area in North Wayne where the tanks are located, a high-class residential and estate section, an effort was made to enhance the architectural appearance of the structures by the inclusion of pilasters in the design. These pilasters were constructed of pneumatic mortar. In the late spring of 1954, the tanks will be painted with a concrete water-type paint.

The total cost of the two tanks, with a total capacity of 10 million gal, was $426,797.45, or about $42,680 per million gal of storage capacity. This cost is exclusive of the yard piping and booster pumping station.

In addition to the Pickering Creek main, the company also constructed 1.06 miles of tar-coated and wrapped steel transmission main of 30-in. outside diameter between the Crum Creek Pumping Station and the existing Maple Reservoir. The construction of this line, started shortly after January 5, was completed and the line placed in operation on June 1. Here large quantities of rock excavation were encountered. The construction cost, including labor and materials as well as all appurtenances, was $35.66 per lin ft.

Development of an additional source of supply will be the next step in the company's long-range program. Perkiomen Creek was chosen for this development after a careful investigation of all the water resources available in the area. The future program includes the construction of a dam on this creek, whence the water will flow 20 miles in the bed of the stream to a low-duty pumping station. The program also includes a water purification plant and a transmission main to tie in with the 42-in. line constructed in 1953. The filtration plant, to be known as the Valley Forge Station, will be situated in the Schuylkill River Valley facing the hills in Valley Forge Park, where George Washington and his Continental Army spent the winter of 1777–1778.

The steel pipe used in the 1953 construction program was furnished by the Bethlehem Steel Company. The Pickering Creek Transmission Main was installed by Armour Excavating Inc., and Charles F. Smith & Sons; the Crum Creek Transmission Main was installed by Armour Excavating Inc.; and the water storage tanks were constructed by the Preload Central Corporation. Albright & Friel, Inc., were the consulting engineers on the projects here described. The booster pumping station equipment was both designed and installed by the staff of the Philadelphia Suburban Water Company under the direction of George H. Dann, M.ASCE, vice president in charge of operations.

Completed Smithland Levee flanks Smithland Cutoff, eliminating costly construction and maintenance of levee that otherwise would have been required around 17-mile bend in river.

FIG. 1. Smithland Cutoff and Levee are part of Red River Backwater Levee Project in Louisiana, being constructed by Corps of Engineers, Vicksburg District.

Navigation maintained during construction

If the Smithland Cutoff on the Black River in Louisiana, in the Vicksburg Engineer District, had involved nothing more than the excavation of a new channel $1^1/_2$ miles long, eliminating a 17-mile bend in the river, it would not have differed much, except in size, from its predecessors on the Mississippi River. The novel feature in the Smithland Cutoff was the use of the excavated material to construct fills across the severed ends of the old channel, and a new levee across the fills, all in sequence and without interrupting river traffic. This was an unusual operation from a planning and construction standpoint.

This situation developed in connection with the Red River Backwater Project, a part of the overall plan for flood control on the lower Mississippi River and tributaries being constructed under the supervision of the Corps of Engineers, U. S. Army.

At a point 10 miles south of Jonesville, La., at Smithland Landing, the Black River starts a long meandering course which, on a run of about 17 miles, doubles back to within 1.5 miles of its starting point. This narrow neck provided an ideal location for a cutoff which would not only benefit navigation and favorably affect flood heights, but also allow construction of a short reach of levee parallel to the cut, eliminating the expensive construction and future maintenance of a levee around the 17-mile bend. In addition, a sizable area of land in the river bend would be given flood protection. See Fig. 1.

Smithland Cutoff

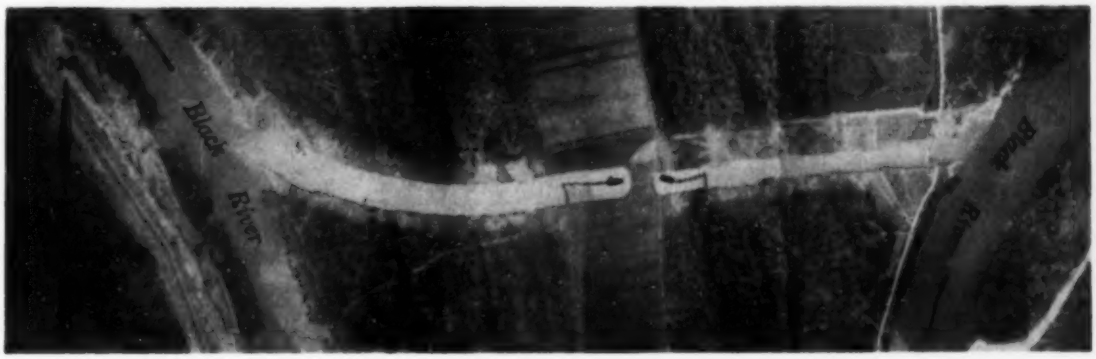
Specifications for the Smithland Cutoff called for the excavation of approximately 3,600,000 cu yd of material, to a cross-section having a bottom width of 150 ft, 1 on 2 side slopes, and bottom grade at El. −3.0 ft mean sea level (M.S.L.), with a tolerance of 2 ft below grade allowed for payment. The average depth of cut was 54 ft. The specifications further required that the excavated material be deposited in fill sections crossing the old river channel adjacent to the upper and lower ends of the cutoff. These fills were to serve as a base for levee crossings. The contractor was required to maintain a navigation channel with a minimum depth of 8 ft and a minimum bottom width of 100 ft at all times, either through the existing channel or through the cutoff.

The contract for excavation of the Smithland Cutoff was awarded to the Central States Dock and Dredging Co., of Des Moines, Iowa, the low bidder at a unit price of $0.16958 per cu yd. The work was subcontracted to and constructed by the McWilliams Dredging Co., of New Orleans, La.

The contractor logically decided to perform the work during the period from January to June, since hydrographs indicated this to be the normal high-water season, when stages of from 24 to 45 ft M.S.L. can be expected. These stages would facilitate the maintenance of navigation before the cutoff could be used, and allow operation on a reduced lift and against a lower bank. It was planned to excavate a partial cut the full length of the cutoff and then to widen this out and deepen it to the required cross section.

The Dredge *Port Arthur* began excavation at the lower end on December 31, 1951, and the *Natchez* at the upper end on January 23, 1952. Both dredges are diesel-electric, cutterhead type, with a 24-in. intake and a 20-in. discharge. The *Port Arthur* started excavation to the full width at El. 20 M.S.L., with a river stage of 39 ft. The *Natchez* also started ex-

In aerial view, dredges *Natchez* and *Port Arthur* approach each other in making initial $1^1/_2$-mile cut to eliminate 17-mile bend in Black River. Navigation was maintained around loop until cut was completed.



W. H. HOLLAND

Chief, Supervision and Inspection, Main River Branch, Construction Division, Vicksburg District, Corps of Engineers

# of Smithland Cutoff and Levee

cavating to El. 20, but to a narrower width to expedite its progress so that the dredges could meet about midway of the cutoff.

The river channel at the sites of the fill areas was about 900 ft wide and 75 ft deep at the upper crossing, and 800 ft wide and 68 ft deep at the lower crossing. The deposit in the lower area, started first, served to increase the velocity of the current at that site and to decrease the velocity of flow at the upper site. The lower fill, consisting of heavier materials, had a relatively small and stable cross-section as compared to the unstable fines retained in the upper area. It was evident that much of the initial deposit in the upper fill would be displaced during subsequent loading.

Rigid deposit control was exercised throughout the life of the contract to insure maximum retention of material in the fill areas. The contractor cooperated fully in changing the direction and elevation of the discharge lines, breaking back of the lines, and using baffles, to meet conditions as they developed. Operations were complicated by rising river stages, swift currents through the gradually decreasing flowage areas at the fill sites, and unstable material, especially in the upper fill area. The originally designed minimum fill cross-section called for 876,000 and 612,000

Plug in initial cut is removed by dredge *Port Arthur* while *Natchez* lies by in background.

cu yd respectively in the upper and lower fills, or a retention of about 41 percent of the estimated cutoff volume.

At the time the partial cut was opened on March 3, 610,000 cu yd of material had been discharged into the upper fill area and 934,000 cu yd into the lower fill area, with 40 percent and 23 percent, respectively, being retained in the theoretical sections.

It became evident early in April, when the cutoff was 69 percent complete, with the upper fill 48.3 percent complete by volume and the lower fill 43.6 percent complete by volume, that neither closure could be made with the material remaining to be excavated. A change order to the contract was therefore issued providing for procurement of approximately 100,000 cu yd of additional material by widening the downstream portion of the cutoff. By varying the depth of cut to obtain the best available materials, and concentrating on obtaining height rather than width on the fill, the closure of the lower crossing was made on May 7, the day the river crested at El. 51.1 M.S.L.

In the meantime the *Natchez* was unable to excavate to prescribed depth in the upper part of the cutoff because of its short ladder and high river stages. The depth of cut was further raised to El. 10 M.S.L. at the request of the Contracting Officer. This was deemed advisable to expedite enlargement of the flowage area through the cut, thus reducing current pressure through the old channel, and also to save heavier materials expected to be found at lower levels for use in the final closure attempt at the upper crossing. The second partial cut was completed on May 9, and the *Natchez* was removed from the job after having excavated, and discharged into the upper fill area, a total of 1,590,000 cu yd of material.

The lower part of the cutoff was completed on May 13, the discharge line shifted to the upper fill area, and the contract completed on June 11, 1952. A total of 3,734,000 cu yd of material had been excavated from the cutoff, with 1,885,000 cu yd discharged into the upper fill area and 1,849,000 cu yd into the lower fill area.

At the time dredging was completed, there remained a short section of the upper fill which was several feet lower than the river elevation of 38.3 ft M.S.L. An emergency closure was therefore made by bulldozer to prevent erosion of the fill by flow from the old channel into the river.

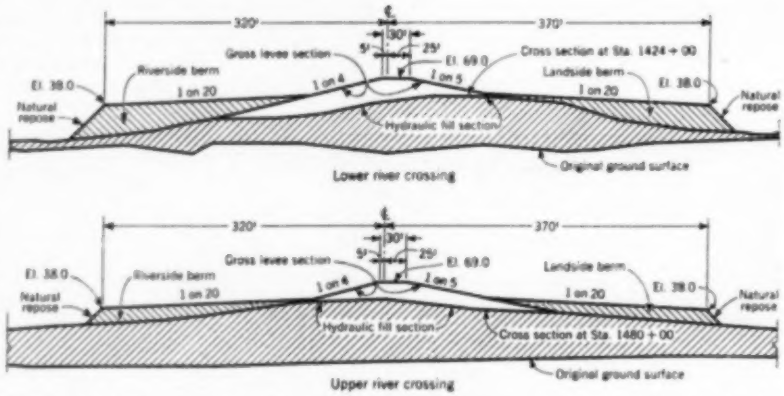


FIG. 2. Typical cross-sections of upper and lower river crossings show completed hydraulic fills, and levee and berm sections constructed on them.

Smithland Levee built

The Smithland Levee parallels the cutoff at a distance of about 1,200 ft, and spans a $1^1/_4$-mile gap between previously constructed levees to the north and south. Standard Red River backwater net levee sections of 16-ft crown (including a 6-ft roadway extension) and 1 on 5.5 landside and 1 on 4 riverside slopes, were applicable to the Smithland Levee, except for crossings of the hydraulic fills, where special design was required. See Fig. 2.

It was determined that the river crossings should be constructed to a

TABLE I. Quantities, cu yd, in designed cross-sections, Smithland Levee

Feature	Upper Crossing	Lower Crossing	Levee in Addition to Crossings	Totals
Levee	143,000	137,000	224,000	504,000
Riverside berm	72,000	96,000	....	168,000
Landside berm	75,000	66,000	....	141,000
Totals	290,000	299,000	224,000	813,000

At lower crossing, swift current complicated closure, which is seen shortly after completion, at right.

gross levee section with a 30-ft crown at El. 69 M.S.L., and 1 on 5 landside and 1 on 4 riverside slopes, plus berms. The outer edge of berm crowns would be at El. 38 M.S.L., 370 ft landward and 320 ft riverward of the levee center-line, with a crown slope of 1 on 20 and a side slope following the natural repose of the material. The gross grade of 69 ft M.S.L. exceeded the net project grade approximately 6.5 ft as compared to the usual differential of approximately 10 percent of the net levee height. This additional elevation was to compensate for expected gradual subsidence and consolidation in the hydraulic fills after completion of the levee.

The approximate quantities required for construction of the Smithland Levee, on the basis of designed cross-sections, are given in Table I.

In view of the unstable nature of the hydraulically placed material in the upper fill, it was estimated that its displacement during levee construction would approximate 200 percent of the levee yardage, and that this displaced material would form the required berms. By making this adjustment and increasing the overall total by 5 percent to allow for probable subsidence on the remainder of the work, an estimated quantity of 1,000,000 cu yd was adopted for advertising purposes. It was realized that this quantity would probably be exceeded since some subsidence of the lower fill could also be expected.

Continued settlement and shifting of the upper fill and a slide in the downstream portion of the lower fill, after completion of the cutoff, emphasized the necessity for specifications with sufficient flexibility to meet conditions as they developed. Specifications for the Smithland Levee prescribed borrow-pit measurement for determination of pay quantities, and allowed a variation of 20 percent in the estimated quantities without adjustment in the unit bid price.

The following method and sequence of operations were prescribed for constructing levee and berms over the hydraulic fills to insure as stable a structure as practicable under existing conditions.

Upper Crossing:

(*a*) Construction of an initial fill starting at one side and proceeding to the other. This initial fill to be at a grade approximately equal to the elevation of natural top bank, with crown width of about 110 ft and side slopes being the natural repose of the material. The center portion of the fill to be constructed ahead to insure that failure of the hydraulic fill would occur immediately adjacent to the center line of the levee. Hauling of material into the initial fill to continue, as soft material in the underlying hydraulic fill was forced out, until a stable crossing was obtained.

(*b*) After completion of the initial fill, a second-stage fill to be constructed thereon to gross levee grade and specified crown width of 30 ft, with side slopes following the natural repose of the material. Work to proceed continuously from one bank to the other. In anticipation of further failures of the hydraulic fill, it was required that material be hauled into the second-stage fill until a stable crossing at gross levee grade had been obtained.

(*c*) The final stage of construction to consist of the placing of additional material to provide the specified side slopes of the gross levee section and to construct the prescribed landside and riverside berms. It was further required that in the event sufficient material was forced from beneath the gross levee section to provide a section equal to or greater than the specified berms, such material would be left in place, only requiring shaping to provide drainage.

Lower Crossing:

(*a*) Construction of initial fill similar to that prescribed for the upper crossing except that construction of the center portion ahead of the main fill was not required.

(*b*) Second-stage fill to be constructed to full gross levee grade and section (30-ft crown at El. 69 M.S.L., with 1 on 4 riverside, and 1 on 5 landside slopes).

(*c*) Final stage to consist of placement of additional material to compensate for subsidence, if any, and construction of prescribed landside and riverside berms.

The contract for the Smithland Levee was awarded to Associated Contractors, Inc., Monroe, La., the low bidder at a unit price of $0.34684 per cu yd. Equipment listed for the work consisted of two draglines, ten 13-cu yd Euclids, and auxiliary plant.

Hauling operations started on July 25, 1952, in the upper fill area. Placement of the first stage of the initial fill was completed without major base failure, but a gradual displacement of material was noted. During the second-stage construction, a series of failures developed as anticipated. As loading increased, there was continuous movement in the unstable hydraulic fill. Displaced material was forced up adjacent to the new fill, and cracks and lateral movement developed far out on the hydraulic fill. On three different occasions during August and early September, the initial fill reached gross grade only to fail shortly thereafter.

On September 13, after a total of 438,000 cu yd had been hauled into the upper fill area, it appeared that sufficient counterweight was available to insure maintenance of the fill to at least El. 59 M.S.L., which would provide flood protection approximately equal to that afforded by previously completed interim grade levees to the south. Therefore hauling operations were shifted to the lower fill area.

Construction of the prescribed gross levee and berms over the lower fill proceeded in accordance with specification requirements. There were some failures in the new fill and movements in a slide area and in the hydraulic fill, but to a much lesser degree than in the upper fill area. The levee and berms over the lower fill were completed to full gross grade and section on November 6, after about 375,000 cu yd had been placed.

While work was being performed on the river crossings, the levee outside these locations had been constructed to a height which would insure flood protection at least equal to that afforded by the partially completed upper fill crossing.

Work on the upper levee crossing was resumed on November 7 and completed on November 23, without any major failures. All embankment in the Smithland Levee was completed on November 26, 1952. The final quantities, as determined from borrow-pit measurement, showed 542,000 cu yd, 375,000 cu yd, and 262,000 cu yd, respectively, in the upper fill area, lower fill area, and the remainder of the levee, totaling 1,179,000 cu yd.

Up to the date of this writing, about a year after completion of the work, there has been no appreciable movement in the levees across the hydraulic fills, and they appear ready for the ultimate test of a major flood and subsequent rapid fall of river stages.

Hydraulic fill at upper crossing was known to be unstable because of character of materials dredged into it. Therefore failures such as that shown were expected when it was loaded with material for levee construction. Additional material was added until stability was secured, unstable material being pushed outward to form berm.

Prestressed deck proves cheapest for new Hoboken pier

THEODORE O. BLASCHKE, A.M. ASCE, Principal Associate
DAVID A. HOPKINS, A.M. ASCE, Design Engineer

Parsons, Brinckerhoff, Hall & Macdonald, New York, N.Y.

The largest ships commonly in use in the general cargo trade will be accommodated at a new fireproof pier, now under construction in Hoboken by the Port of New York Authority. This steel and concrete pier, the first new one to be built in Hoboken in 25 years, is the initial major feature of the Authority's $22,000,000 program to improve the Hoboken waterfront. The pier is on the site of the Federal Maritime Commission's former Piers 4 and 5, which were completely destroyed by fires in 1921 and 1944.

The new pier is part of the marine terminal which extends along the Hoboken waterfront from Newark Street north to Fourth Street, consisting originally of six piers, three of which (namely, 1, 2 and 3) and the headhouse structure, shown in Fig. 1, are still in use.

In addition to the new Pier C now under construction, the Port of New York Authority's lease stipulates that another pier, to be designated B, will be built within seven years to replace existing Pier 3, and the Authority has an option, to be exercised within ten years, to build a third pier, A, which will replace existing Piers 1 and 2. The new construction is under a tripartite agreement, made final in September 1952, whereby the terminal is leased by the U.S. Government to the City of Hoboken, which in turn subleases the entire facility to the Port of New York Authority.

The pier now under construction has a deck with an overall length of 700 ft from the bulkhead line, and a width of 328 ft. This deck supports a transit shed 683 ft long by 286 ft wide with a minimum under-truss clearance of 20 ft. Exclusive of office and toilet facilities, this provides 190,000 sq ft of covered transit and storage area with 20-ft aprons along the south side and at the offshore end, and a 25-ft apron along the north side.

Fireproof construction

The pier is of fireproof construction consisting of a prestressed concrete deck supported on steel H-piles and a transit shed with structural steel frame, steel deck roof, protected metal siding, and a brick masonry facade at the inshore end. The present contract provides for dredging to 30 ft below mean low water, which will accommodate cargo ships of the Mariner type. The design provides for dredging to 35 ft anticipating possible future ship design. Smaller ships also can be berthed at the offshore end of the pier.

The design of the new pier represents a major step forward in pier planning. It can be seen from Fig. 2 that the column spacing is liberal and that both rail and truck access are provided for freight handling. Generous circulating and storage areas are provided, affording economy of operation and maintenance.

Truck access to the deck of the pier is provided by ramps from the bulkhead platform at the inshore end, and by the north apron slab, where the bulkhead platform elevation is the same as the pier deck. Also, trucks may be backed up to the loading platform, which extends along the inshore end of the pier shed, to load or discharge freight at truck-floor level.

Rail access is provided by two tracks in a railroad well, extending 500 ft down the center of the pier, along which freight may be loaded or discharged at car floor level. An additional track is provided flush with the deck on the north apron, so that freight may be handled directly from car to ship. Other facilities provided on the pier include receiving and delivery offices, checkers and customs offices, and toilets. Provision was made in the design of all facilities so that a fence located along the longitudinal centerline of the pier will divide it into two separate operating areas in the event that the pier is leased to two tenants.

Boring records at the site of the pier show that rock is approximately 140 ft below mean low water at the offshore end of the pier, and 90 ft below mean low water at the bulkhead line. The rock is serpentine, decomposed on the surface, and at places overlain with dense sand. Above this is Hudson River silt, semi-liquid on the surface, becoming more dense and cohesive at increasing depths. During the preliminary design and in the final design stages, a number of possible types of construction were investigated, and it was found that a concrete deck on steel H-piles was the lowest in cost. A study of H-pile bearing capacities when driven to rock through this soft silt showed that a 14BP89 section would safely support a load of 90 tons, and this value was adopted as a maximum for design purposes. As a check on the

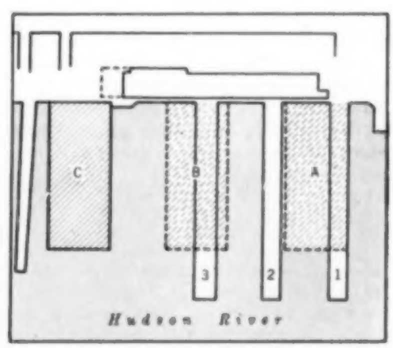
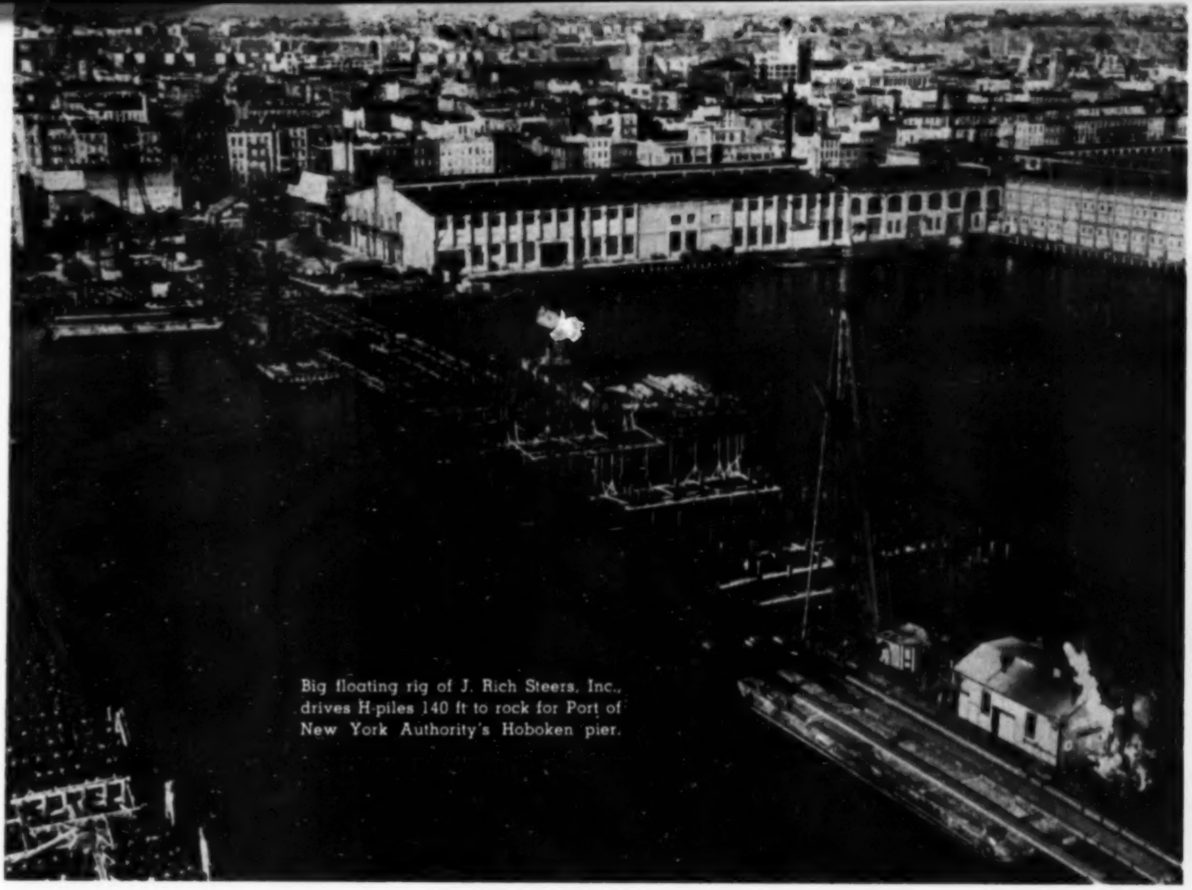


FIG. 1. Location of Pier C, Hoboken, N. J., is on site of old Piers 4 and 5 previously destroyed by fire. Eventual development calls for construction of two more piers to replace existing Piers 1, 2, and 3.



Big floating rig of J. Rich Steers, Inc., drives H-piles 140 ft to rock for Port of New York Authority's Hoboken pier.

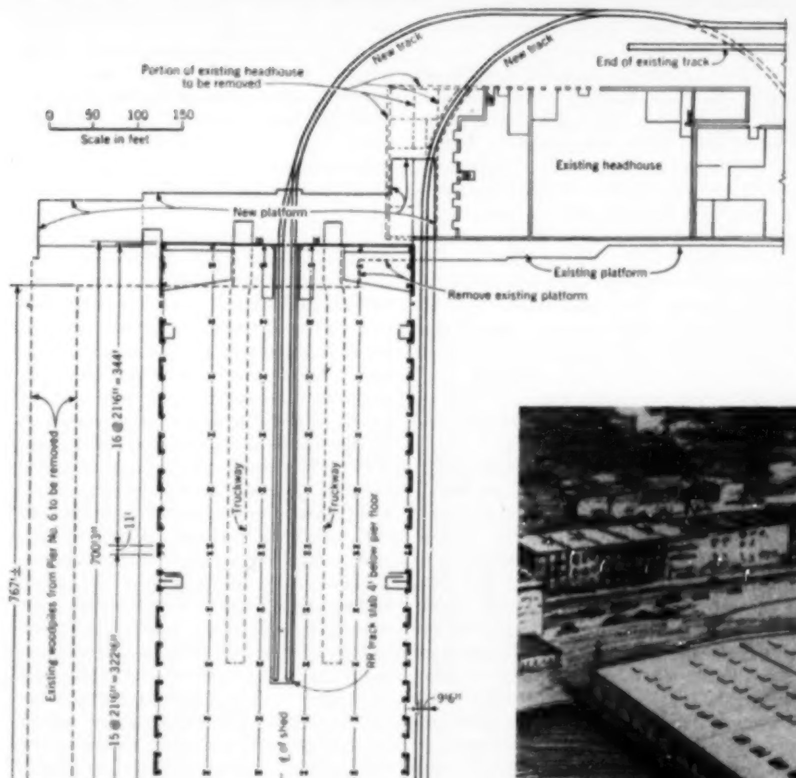
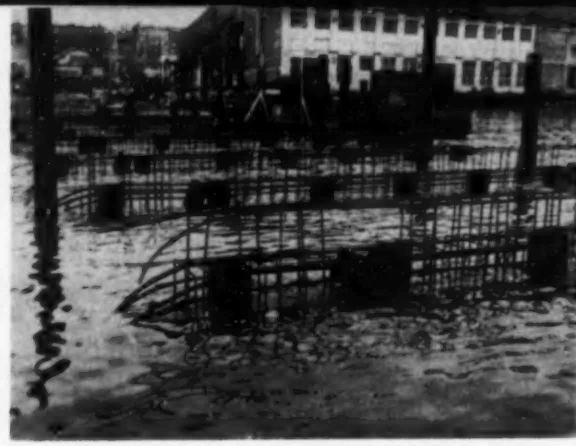


FIG. 2. Spaciousness of work area on Pier C, to be widest in Port of New York, is evident from open column layout. Railroad tracks down middle of pier are depressed to permit unloading at platform level. Plan is arranged so as to permit use of pier by two tenants.

Below:

Pier C in Hoboken is shown as it will appear when completed in March 1955. Cost of the pile-supported structure will be over $5,000,000. Alternative of pre-stressed deck was choice of four out of five low bidders. Steel piles are cathodically protected.



1

Pile caps, seen before (1) and after (2) in-place casting, have depressed key to receive precast stringers. Prestressing cables, in flexible tubes, will be stressed after stringers are in place. In

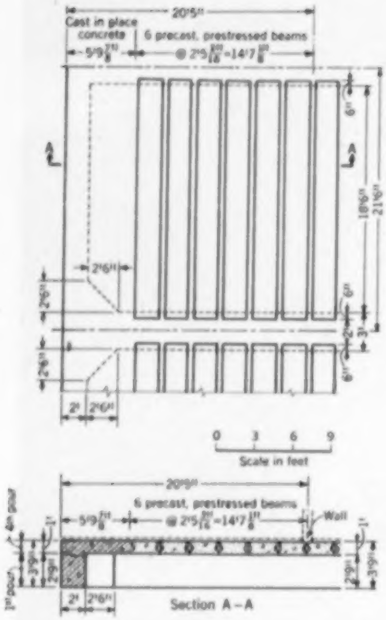


FIG. 3. Plan and section show arrangement of pretensioned stringers, which rest on cast-in-place pile caps. Pile caps will be post-tensioned.

design bearing capacity, a test pile has been driven and loaded to 150 tons. There was no appreciable settlement.

Studies of the relative economy of conventional concrete and prestressed concrete construction for the deck were made, and although the engineer's cost estimates indicated the prestressed concrete to be cheaper, alternate schemes incorporating both conventional and prestressed concrete were put out for bids. At the bidding, the engineer's original estimates were confirmed. Out of five bidders, the four lowest submitted a proposal for the prestressed concrete alternate.

The concrete deck of the pier will have a 2-in. bituminous wearing surface, which is preferable for cargo handling operations with fork-lift trucks. The truck circulation area at the inshore end of the pier is also to be paved with a bituminous surfacing. Other facilities at the inshore end include new entrance gates, a new gatehouse, and new connections to existing trackage.

Pier shed is steel frame

The pier shed is a structural steel frame, supporting protected metal siding with an aluminum finish and an insulated steel roof deck. Since the side walls of dock sheds are particularly liable to damage by rough cargo handling, an 8-ft-high concrete perimeter wall replaces the lower part of the siding on both sides and on the offshore end. The inshore facade is of brick masonry, architecturally treated to present a pleasing aspect from the shore side of the pier. Roller shutter doors 20 ft wide and 16 ft high are located on each side of the shed and on the offshore end. In general, the doors will be manually operated, but the rail and truck entrance and exit doors are provided with electrical operation.

Other features include complete sprinkler and standpipe fire protection, American District Telegraph Co. alarm system, fluorescent lighting at 7 ft-candles minimum, roof skylights spaced to give a high standard of daylight illumination, continuous ridge ventilation, and ship service outlets for water and electric power. To avoid encroachment of valuable pier space by non-productive operations, office and storage space for maintenance and supervisory staff will be provided in the southerly end of the existing headhouse.

Concrete deck prestressed

The prestressed concrete deck (Fig. 3) consists of two major elements—pretensioned precast stringers and post-tensioned pile-cap bents. The pretensioned stringers, now being cast in the contractor's yard, are flat I-section slabs 2 ft 5 in. wide, 1 ft 0 in. deep, and 19 ft 6 in. long. They are pretensioned with $^5/_{16}$-in.-diameter wire strands of high tensile strength. The stringers span between the pile-cap beams, which are spaced at 21 ft 6 in. on centers, and are provided with longitudinal keys that will be filled with concrete after the stringers are placed. The pile-cap beams will be cast in place and, to provide lateral compression in the deck slab, they will be tensioned after the poured-in-place stringer keys have set.

The only major item of timber construction on the pier is the fender system, which will consist of greenheart fender piles at 7-ft spacing, and a cluster of piles at each offshore corner of the pier to form a knuckle. The greenheart piles and chocks are backed by pine wales—a softer wood to provide resilience for berthing ships. Since the structure itself with its long steel bearing piles and batter piles, is semiflexible, the deflection energy of the pier plus the compressibility of the fender system will be more than adequate to absorb the energy of impact for normal berthing.

At the inshore end of the pier, an existing timber pile wharf and the south end of the headhouse are being demolished to make way for the new pier. The remaining timber piles of former Pier 6, at the southern boundary of the property, have been extracted. An existing timber bulkhead, which is believed to have a timber crib and riprap foundation, will be left in place. It was decided to leave this bulkhead in position, and to buttress the south end with a three-cell sheetpile cofferdam to obviate the possibility of lateral soil movement due to dredging on the south side of the pier. The organic silt inside the cofferdam will be stabilized by sand drains and a surcharged sand fill. The cofferdam will remain as part of the permanent construction. The bulkhead platform, which extends over the cofferdam and along the inshore end of the pier, is similar in construction to the main pier deck.

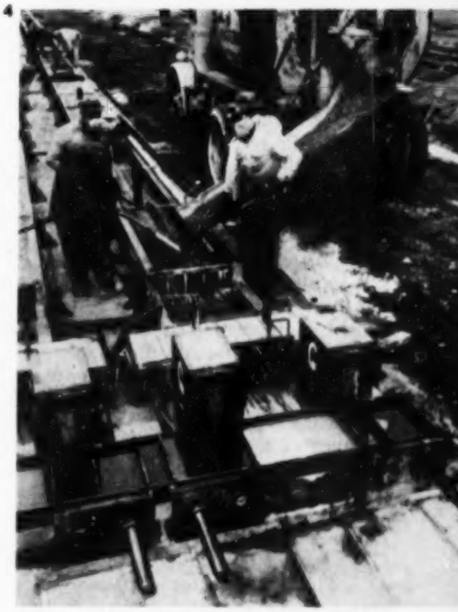
A corrosion control survey at the site revealed the presence of stray

2

3

contractor's yard, bare cables, placed in stringer forms (3), are anchored and tensioned before concrete is poured (4). Pretensioning benches were designed by Freyssinet Co.

4



electric currents of considerable magnitude and indicated that unprotected steel probably would corrode at the rate of 0.003 to 0.005 in. per year just below mean low water, and at slower rates throughout the remainder of the pile length. This necessitated consideration of some means of protection against corrosion. This protection could be provided by concrete jackets and a heavy application of bitumastic paint, or by the installation of a cathodic protection system. A cost analysis showed that cathodic protection was more economical.

The cathodic protection system (Fig. 4) consists of 200 graphite anodes suspended between the piles below mean low water. Low-voltage direct current (10–15 volts) is supplied to these anodes by selenium rectifiers mounted above the lower chords of the pier-shed roof trusses. An earth return circuit to the rectifier is provided by welded connections from the piles to the reinforcing steel in the deck and to the structural steel frame of the shed. The river water thus acts as an electrolyte, and the pile acts as a cathode. The chemical action is complex and involves the slow destruction of the anode over a period of years, the release of gas at the anode, and the deposition of salt coatings on the steel pile.

The piles will be treated initially with a coating of cold bitumastic emulsion paint, and the cathodic protection will be effective immediately for areas where the paint has been damaged and the steel exposed. As the paint deteriorates, the cathodic protection gradually increases its effectiveness, until eventually the whole of the pile is coated with deposited salts. It is expected that the system will afford almost complete protection from corrosion below mean low water for the life of the pier, at an estimated cost of approximately $3.00 per pile per year for current and maintenance.

The construction cost (based on bids received) of the pier together with the bulkhead structure and truck circulation area at the inshore end, and including steel H-piles purchased by the Port Authority, will be $5,200,000. The mechanical and electrical rehabilitation of the existing headhouse will represent an additional investment of $440,000.

Overall responsibility for the project rests with John M. Kyle, M. ASCE, Chief Engineer of the Port of New York Authority. Directly associated with him on the design work were John J. Fitzgerald, Jr., Deputy Chief Engineer, and Irvine P. Gould, M. ASCE, Assistant Engineer of Design. Robert E. Schulze, Marine Terminals Manager, was Adviser on Planning. The Resident Engineer for supervision of construction is Eric Barron.

Plans for the entire project, including rehabilitation of the headhouse, were prepared by Parsons, Brinckerhoff, Hall and Macdonald, with Maurice N. Quade, M. ASCE, as Partner in Charge. The writers were Project Engineer and Design Engineer respectively. Niels Thorsen, A. M. ASCE, of the Freyssinet Company, supervised the preparation of the prestressed concrete alternate design, and L. P. Sudrabin, of the Electro Rust-Proofing Corporation, served as consultant for the design of the cathodic protection system.

The contract for construction of the pier was awarded to J. Rich Steers, Inc., New York, with Eugene Rau as Project Manager, at a bid price $4,393,200.

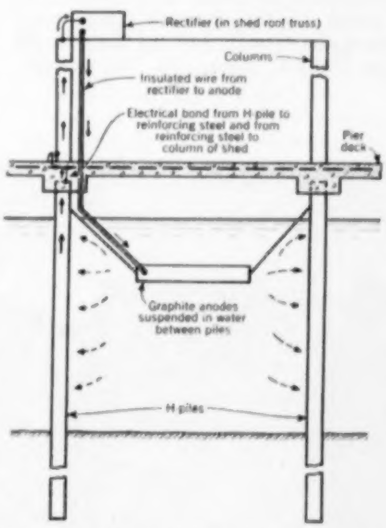


FIG. 4. Corrosion of piles is prevented cathodically. System uses 10 to 15 volts and will cost about $3 per pile per year throughout whole life of structure.

Forecasting

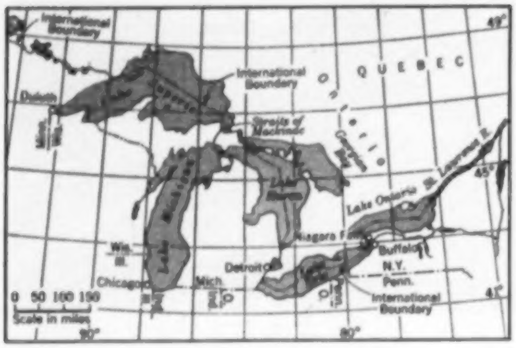


FIG. 1. Great Lakes provide unique transportation highway and vast natural reservoir for hydroelectric power. They also have great recreational value and influence on climate of surrounding area.

Uncounted thousands of years in geologic evolution have placed near the middle of the North American continent the earth's largest concentration of fresh water. The vast inland seas formed by these waters, known as the Great Lakes, provide a transportation highway unique in the world, great natural reservoirs for hydroelectric power, and unparalleled recreational facilities. They also exert a significant influence on the daily weather and general climate of the region. At the same time they pose what is probably one of the most complex of hydraulic problems.

With the exception of Lake Michigan, which lies entirely within the United States, the Great Lakes form the international boundary between Canada and the United States (Fig. 1). The total water surface covers about 95,000 sq miles, approximately the size of the State of Oregon. The length of the through-vessel track from the easterly end of Lake Ontario to Duluth, Minn., at the westerly end of Lake Superior, which includes the full lengths of Lakes Ontario, Erie, Huron and Superior, plus connecting waters, is approximately 1,200 miles. There is an additional length of 1,000 miles in the St. Lawrence river which vessels from the Atlantic Ocean must traverse to reach the easterly end of the Great Lakes. The net yield of water from this enormous basin flowing out of Lake Ontario through the St. Lawrence River to the ocean averages over 230,000 cfs.

Significance of lake levels

Levels of the water surfaces of the Great Lakes have varying effects on three major economic interests—shore property, lake shipping, and hydroelectric power. In general, high levels benefit shipping and power. Increased depths in harbors and channels, which permit vessels to load only an inch or too deeper, permit sizable increases in cargoes, particularly in the huge modern lake freighters. Production of hydroelectric power is obviously facilitated by an abundance of water. But high lake levels are extremely injurious to shore properties, particularly during storms. A typical instance of damage wrought by Lake Michigan during the past two years of record and near-record high water levels is illustrated. Periods of low lake levels likewise present problems. For example, maintenance of high flows for power would further decrease the drafts to which vessels on the Great Lakes could be loaded.

There is no way to solve these problems with the lakes in their present unregulated state, since the recurring highs and lows are natural and not man-made. Lake Superior is the only lake for which the means of regulation—the compensating works at Sault Ste. Marie—are available, but since the regulation which has been imposed has controlled the lake level essentially within the range that would have existed had the lake

←
Record and near-record high water on Great Lakes in 1951 and 1952 caused much damage to shore property as illustrated by photo taken by Charles T. Martin of *Detroit News* on shore of Lake Michigan.

→
FIG. 2. Hydrographs show predictions (dashed blocks) for one winter low and two summer highs as compared with actual levels which occurred on Great Lakes. Predictions of U.S. Lake Survey were generally accurate within 0.3 ft.

Great Lakes levels aids power and navigation

LOUIS D. KIRSHNER
M. ASCE

Assistant Chief, Engineering Division
U. S. Lake Survey
Corps of Engineers, Detroit, Mich.

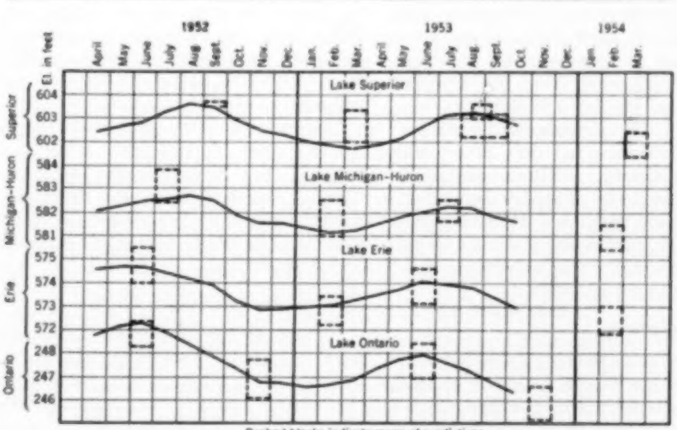
been unregulated, the effect has been but small and temporary.

It has long been recognized that accurate forecasting of lake levels would enable each interest to gain some measure of protection against oncoming highs and lows which might be damaging. A number of studies to this end have been made in the past by leading hydraulic engineers, but until recently it was believed inadvisable to forecast lake levels more than one month in advance.

First forecast issued

In January 1952, the Corps of Engineers, U.S. Army, through the U.S. Lake Survey, which is charged with the Corps' responsibilities relating to the hydraulics and hydrology of the Great Lakes, issued the first long-range forecast of the peak levels which the lakes might be expected to reach in the summer of 1952. With the lakes already at levels damaging to shore properties, it was believed that even a rough estimate, based on the experience centered in the U.S. Lake Survey, would be better than no estimate at all. A forecast was therefore prepared by the writer, using extremes and averages of past lake-level changes, analyses of conditions in the drainage basin, and long experience in watching the rise and fall of the lakes. That the ensuing actual peaks were as close as they were to the predicted peaks, was perhaps fortuitous.

Following this first forecast, the Lake Survey engaged in an intensive study to develop a better basis for future predictions. The study is continuing and is expected to establish relationships between lake levels and factors such as antecedent precipitation, evaporation, and ground water that will permit a more precise analytical determination of future levels. However, until this study is completed, an interim method has been developed, based on statistical analysis of past records qualified by certain factors of judgment, and this is the method to be described here.



Dashed blocks indicate range of predictions

Figure 2 shows hydrographs of the Great Lakes on which are indicated the forecasts made in January 1952 for the following summer highs, and predictions of future levels made by the statistical method to be described. Lake Survey gage records cover the period from 1860 to the present, and in this period several marked highs and lows have occurred. While the high levels of 1951 and 1952 were record or near record on all the lakes, they have been closely approached in the past and undoubtedly will be reached again.

Changes in level analyzed

Mean water-surface evaluations of the lakes are the result of all the factors which either add or subtract water. Water is added by precipitation on the lake surface, tributary stream runoff, diversions into the lakes, condensation on the surface, inseepage, and inflow from the lakes above. Water is subtracted by outflow to the lakes below, evaporation, diversions from the lakes, and outseepage.

Analysis of past monthly average lake levels shows three distinct components: (1) the general yearly elevation; (2) a seasonal component; (3) a residual irregularity in the monthly mean, here called an irregular.

The general yearly component is indicated by an upward or downward trend in the level not due to seasonal factors. The rate of this movement and its duration are extremely uncertain. In 93 years of study, the U.S. Lake Survey has observed no regular cycles in the general yearly elevation of lake levels.

The seasonal component is a regular cyclical variation of levels with a period of one year and a constant value each month for each of the Great Lakes. Freeze-up of tributary streams and storage of water by winter locking of the drainage basin by freezing almost invariably cause

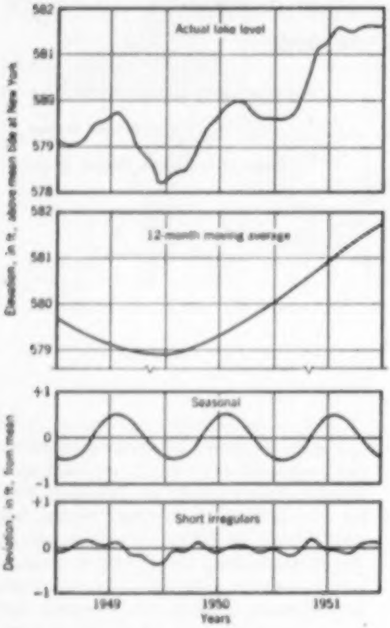


FIG. 3. Typical hydrograph of monthly mean elevation, for Lake Michigan–Huron, (at top) is broken up into three components below. This method of breaking up hydrograph into components makes it possible to eliminate errors in extrapolating curves into future.

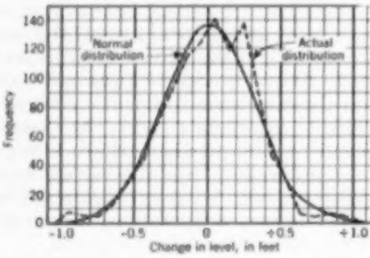


FIG. 4. Changes in general yearly component during a six-month period for Lake Michigan–Huron follow normal curve closely. Curve for normal distribution shows 12-month moving average.

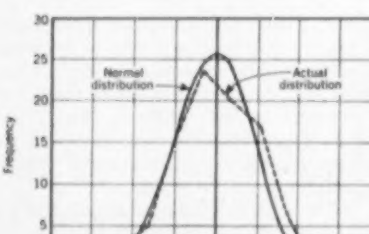


FIG. 5. Curves for Lake Michigan–Huron, 1860–1951, compare normal distribution with actual distribution of irregulars.

lake levels to reach a low point during the winter. Subsequent release of the stored water, plus generally heavier precipitation in the spring, causes the levels to reach a high point during the summer. The months in which the highs and lows occur vary from lake to lake and, for a given lake, from year to year.

Irregularities of monthly mean levels are residual changes which cannot properly be classified as either general, yearly or seasonal changes. They are undoubtedly caused chiefly by excesses or deficiencies of precipitation as compared to the normal monthly pattern. But evaporation and ground-water movement, about which little is known, must also be considered important factors.

The three components of monthly mean elevations for Lake Michigan–Huron are shown in Fig. 3, as well as their total, the monthly hydrograph.

General yearly component

The general yearly component is considered well represented by a 12-month centered moving average of the monthly mean elevations. The 12-month centered moving-average lake level for April 1952, for example, is calculated by totaling the 12 monthly elevations from October 1951 through September 1952 and the 12 monthly elevations from November 1951 through October 1952 and dividing the total by 24. Such a moving average removes the seasonal pattern entirely and the major part of the irregulars. The resulting data appear as a smooth curve oscillating with a varying amplitude and period.

Changes in the general yearly component during the six-month period follow the normal curve quite closely. Figure 4 shows a frequency distribution of the six-month changes of the 12-month moving average for Lake Michigan–Huron as well as a fitted normal distribution. A test of the hypothesis of normality shows that the actual distribution is not significantly different from the normal distribution at the 0.05 level of significance. The average and variance of the distribution are zero and 0.100 ft^2, respectively. These statistics measure the error made by assuming, for predictive purposes, that the general yearly component of the level of each lake will remain the same during the next six months.

Seasonal patterns

The seasonal pattern (see Table I) of each of the Great Lakes is closely approximated by the average deviation of the actual elevations from the 12-month moving average elevations

TABLE I. Seasonal components of Great Lakes levels, 1860–1951, in ft

Month	Superior	Mich.–Huron	Erie	Ontario
Jan.	−0.26	−0.45	−0.53	−0.64
Feb.	−0.45	−0.47	−0.50	−0.56
Mar.	−0.56	−0.39	−0.40	−0.29
Apr.	−0.51	−0.16	+0.15	+0.32
May	−0.19	+0.15	+0.50	+0.67
June	+0.10	+0.39	+0.67	+0.82
July	+0.31	+0.53	+0.64	+0.76
Aug.	+0.41	+0.48	+0.44	+0.44
Sept.	+0.44	+0.29	+0.16	+0.03
Oct.	+0.40	+0.08	−0.16	−0.33
Nov.	+0.26	−0.13	−0.42	−0.57
Dec.	0.00	−0.33	−0.49	−0.64

for all Januaries, Februaries, Marches, etc. Thus for each month during the period of record (except the first 6 months, and the last 6 months, because of the mechanics of the moving-average technique) there is a 12-month moving-average value (the general yearly component) which contains no seasonal pattern. The difference each month between this value and the actual elevation is consequently a rough estimate of the seasonal value.

These estimates differ from each other as a result of short irregular fluctuations. However their average (that is, the means of all 91 January estimates, all 91 February estimates, etc.) provides a very close approximation to the true seasonal value for each month, because the process of averaging over a considerable period removes most of the irregularities. The reliability of the average of the seasonal estimates as an estimate of the true seasonal influence is measured by the standard error. The standard error of these averages varies from 0.014 ft in November on Lake Michigan-Huron to 0.041 ft in March on Lake Ontario. It is highly unlikely that the seasonal components in Table I are in error by more than three standard errors, a very small amount in most instances.

The seasonal pattern for each of the Great Lakes is different. Table I shows Lake Ontario leading the parade of seasonal rises and falls and possessing the largest seasonal amplitude. The other lakes follow in an upstream order.

Residual irregularities

Irregulars are the erratic, residual movements in the lake elevations which remain in the hydrograph after the general yearly movement (the 12-month moving-average values) and average seasonal patterns have

been removed, that is, for each month,

Irregular = (actual mean elevation) − (12-month moving average value) − (seasonal value for that month)

The irregulars are normally distributed about a mean of zero when ordering through time is neglected. A frequency distribution of the irregulars for January on Lake Michigan–Huron and a fitted normal curve appear in Fig. 5. According to a chisquare test, there is a 50-percent probability that a chance divergence between the actual and the normal distribution will be as great or greater than that observed. Thus the hypothesis of normality cannot be disproved and the fit may be considered good. This fact is useful for predictions. Although it is impossible to know six months in advance the magnitude and direction of an irregular, it is possible to set probability confidence limits for its value.

The actual mean elevation for any of the Great Lakes is thus the sum of three factors, two of which closely follow the normal distribution and one of which is defined as constant (the hypothesis of a progressive change in the true seasonal pattern, perhaps because of a gradual deforestation, has been found untenable) for all months with the same name. Thus for any month,

Actual mean elevation = (general yearly component) + (seasonal) + (irregulars)

Consequently, when ordering through time is neglected, the actual mean elevations for any month (that is, for all Januaries or all Februaries, etc.) will also follow the normal distribution closely.

Forecast in three parts

The current method employed by the U. S. Lake Survey in forecasting future Great Lakes levels is based on the foregoing analysis. The forecast consists of three parts: (1) obtaining a single best estimate for the future level; (2) obtaining a range, centered on the best estimate, of sufficient breadth to give the desired confidence; and (3) the adjustment of the above forecast to allow for the fact that the values of the general yearly movement are ordered through time and are not mutually independent. The last step, for want of a better name, is called a judgmental adjustment and includes such qualitative factors as wetness of the drainage basin, current movements in the general yearly factor, behavior of precipitation, and outflow regimen changes.

The best estimate of the future level for each lake is made by totaling the best estimate of each of the components in the above equation. The general yearly component is estimated by assuming no change in the approximate current value of the 12-month moving average. Unfortunately the 12-month moving average is always six months out of date. However, the current value may be approximated by subtracting the seasonal value of the current month from the actual mean elevation of that month and assuming the current irregular to be zero. The error in this step is measured by the variance of the current seasonal value and the variance of the assumption regarding the irregular. The extrapolation step is also subject to error measured by the variance of changes in the moving average during the predicting period. These errors are recognized later in determining a suitable range.

The seasonal value of the forecast month, obtained from Table I, is then added to the extrapolated general yearly value derived as in the preceeding paragraph. Since the best estimate of the irregular influence is zero, the result of this step is the best estimate of the lake level. The error in this step, which also is recognized later, is measured by the variance of the forecast seasonal and the variance of the forecast irregular (forecast of zero).

The foregoing computation and the steps which follow, leading to a prediction, is illustrated most effectively by an actual computation. For example, the level which Lake Michigan–Huron is expected to reach at the winter low during 1953–1954 was predicted early in September, based on the mean August lake level, and the calculation was as follows:

	Operation	Value
	Mean level, August 1953	582.13 ft
1.	Less current seasonal (Table I)	−0.48
2.	Less assumed current irregular	−0.00
3.	Extrapolated general yearly component	581.65
4.	Plus winter low seasonal	−0.53
5.	Plus assumed winter low irregular	0.00
	Best estimate for winter low	581.12 ft

The winter low seasonal of a given lake is the average of all observed departures of the winter low level from the associated 12-month moving average level of the lake.

Accuracy evaluated

The range of confidence to be applied to the above best estimate is measured by the standard deviation of the forecast. As the standard deviation of the sum of a number of variables, it equals the square root of the five variances involved. Thus:

$$\underset{\substack{\text{Estimate for}\\\text{winter low}}}{\sigma} = \sqrt{\underset{\substack{\text{Seas.}\\\text{for}\\\text{Aug.}}}{\sigma^2} + \underset{\substack{\text{Irreg.}\\\text{for}\\\text{Aug.}}}{\sigma^2} + \underset{\substack{\text{Changes}\\\text{in}\\\text{12-mo.}\\\text{aver.}}}{\sigma^2} + \underset{\substack{\text{Seas.}\\\text{for}\\\text{winter}\\\text{low}}}{\sigma^2} + \underset{\substack{\text{Irreg.}\\\text{for}\\\text{winter}\\\text{low}}}{\sigma^2}}$$

The variance of the seasonals is so small that it is neglected. Consequently the standard deviation of the forecast for the 1953 winter low is:

$$\sqrt{0.032\ \text{ft}^2 + 0.100\ \text{ft}^2 + 0.013\ \text{ft}^2} = 0.380\ \text{ft}$$

Since the range is to be such that the prediction would be right about 95 percent of the time, two standard deviations were added to and subtracted from the best estimate, thus

$$\text{Best estimate} \pm 2\sigma_{\text{Est.}} = \text{limits of range}$$

$$581.12 \pm 2\,(0.380) = 580.36 \longleftrightarrow 581.88\ \text{ft.}$$

In September of 1953, the graph of the 12-month moving average of Lake Michigan–Huron levels tended to indicate a general downward trend. Serving to corroborate this indication was the deficiency of precipitation for the 4 weeks just preceding the forecast. Precipitation had been near or above normal during the early summer months but exhibited a steady decline toward subnormality. Consequently, the prediction for Lake Michigan–Huron was lowered to the following:

Low	Midpoint	High
580.4	580.9	581.4

The above forecast, those for the other Great Lakes, and previous predictions by this method are shown in Fig. 2.

Unfortunately no means for quantitative evaluation of the judgmental factors has been found to date. Correlations between lake elevations, ground water, precipitation, temperatures, etc., have not yet been established by the study; and although the study of these and other factors continues, predictions at the current stage of the study for more than two months in advance are best made by statistical analysis of past levels and by totaling the three components of lake elevations and explained in the foregoing example.

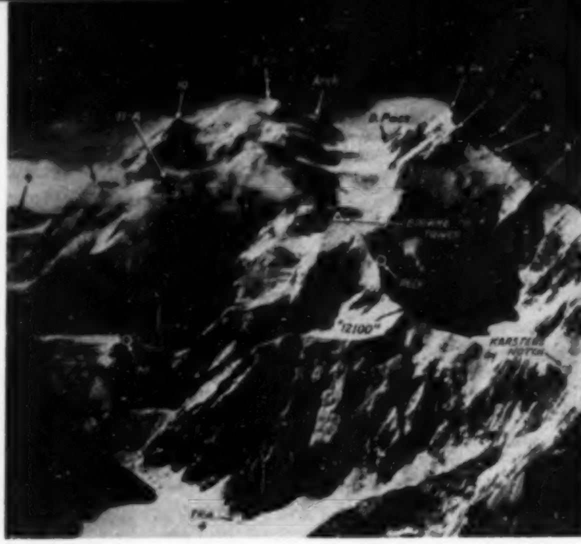
The application of statistical analysis to the forecasting of Great Lakes water levels was developed under the general direction of the writer by Ronald S. Johnson, University of Michigan, statistical consultant for the U. S. Lake Survey. Lt. Col. William N. Harris is District Engineer, U. S. Lake Survey, under the Great Lakes Division, Corps of Engineers; and Col. W. P. Trower is Division Engineer.

FIELD HINTS

On-the-spot photographs expedite Mount McKinley survey

BRADFORD WASHBURN

Director, The Museum of Science, Boston, Mass.



Complexity of Mount McKinley's slopes made designation of individual points onerous by sketching, but photographs taken by Polaroid Land camera, and developed on the spot, could be quickly and clearly labeled, as shown.

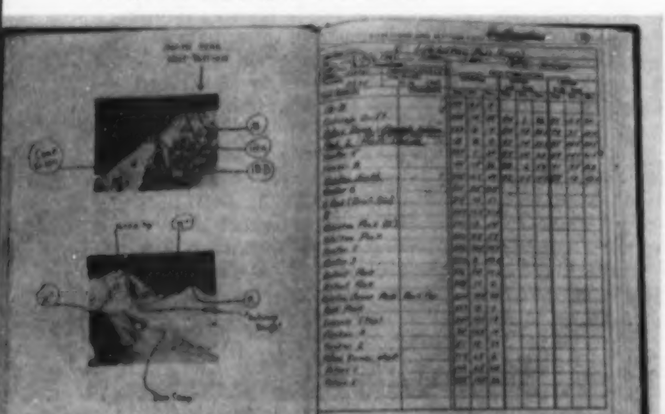
Till seven years ago, precise surveying equipment had never been taken onto Mount McKinley in Alaska, and North America's highest peak had never been accurately mapped. Since the recent war, military aircraft have made a number of high-altitude flights over this part of the Alaska Range, and McKinley has now been completely covered with stereoscopic vertical photographs, taken from more than 30,000 ft above the ground. Using these photographs, but with very little reliable ground control in the vicinity of the high peaks, the U. S. Geological Survey has recently published a new shaded-relief contour map of McKinley Park on a scale of 1:250,000.

To obtain precise control for a large-scale map of the extremely rough, glaciated terrain immediately around Mount McKinley, now being compiled at Boston's Museum of Science, we have made a number of small expeditions onto and around the mountain since 1947. (See *National Geographic Magazine,* August 1953.) Wild T-3 and Zeiss theodolites have been used for this work, which has been carried out under the sponsorship of Dr. A. Hamilton Rice of New York. During 1952 and 1953, our McKinley network was tied into the Alaska triangulation scheme by two U. S. Coast and Geodetic expeditions led by Lt. Commander Howard S. Cole.

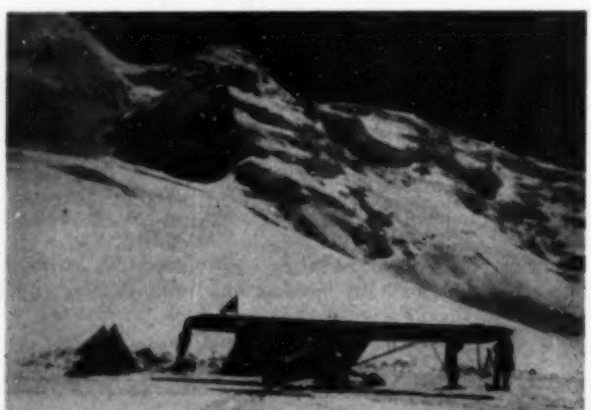
Aside from very heavy dependence on radio, air-drop, and ultra-high landings by ski-equipped aircraft, one of the unusual techniques employed by our parties working in the McKinley massif has been the use of the Polaroid picture-in-a-minute camera up to altitudes of 12,500 ft, to minimize the need for field sketching in our angle-books. The wilderness around this great peak is unusually complex, and only a very few of the major neighboring peaks, ridges, and glaciers have yet been named. Up until two years ago the accurate identification of the features sighted from our survey stations required us to make extremely detailed pencil sketches in our angle-books, each observed point being given an identifying letter or number. Even at stations in the lowlands, this was rarely a warm and pleasant job. At high altitudes, the work of sketching and recording with numb, clumsy fingers was indeed a miserable assignment.

In mountain country like this, where the weather is constantly changing and unreliable, it is most exasperating to have to spend the first half-hour (or more) at each station carefully making a panoramic sketch of the terrain to be surveyed—particularly if the weather is rapidly worsening, and speedy observations may save repetition of a long climb

Photos were immediately stuck in angle-book with adhesive tape, and each observed point was given identifying letter or number.



Our surveys in McKinley area have also pioneered in heavy dependence on radio, air-drop, and ultra-high landings by ski-equipped planes.



with heavy packs. By keeping the Polaroid camera and film warm, by packing them next to my back in a rucksack, we found it possible to complete this part of our job more accurately and rapidly than ever before, even at stations where the air temperature was considerably below freezing—down to about 20 deg F.

It took only a few minutes to expose and develop a panorama of the pictures required for identification of all the points we were about to shoot with the theodolite. The pictures were then stuck in our angle-book with adhesive tape and each point labeled with pencil on the spot. Although pencil does not show up well on glossy prints, it embosses the paper slightly and these marks can be seen clearly in the field by tilting the print slightly against the light. Of course they are permanently inked in at camp in the evening. We rarely put names directly on the prints, but drew lines from the desired points to the margin (see illustration) where the designations could be written quickly and easily.

Not only did this new technique speed up our field work and make it more precise, but the multiplicity of additional detail available in the photographs made it possible to take directions and elevations on many obscure points which we could never have identified accurately on sketches. Furthermore, we were able to start our instrument work just as soon as the theodolite was leveled. This was frequently most important, as the efficiency of an observer and recorder declines rapidly at one of these chilly mountain stations. The sooner they can get to work before the elements have begun to take their toll, the better the results will be.

The contrast in our photographs could be fairly well controlled by the length of development. If we made a mistake, we could try again, till the error was corrected. Despite the fact that the film is not supposed to be used under conditions much below freezing, we were always able to get results that were satisfactory for our needs.

ENGINEERS' NOTEBOOK

Sectional properties of corrugated sheets determined by formula

DON S. WOLFORD, A. M. ASCE

Research Mechanical Engineer, Armco Steel Corporation, Middletown, Ohio

A set of related formulas for quickly determining the cross-sectional properties of common corrugated sheets is here presented. With the cross-sectional properties known, the loads that corrugated sheets will carry as beams and columns can then be computed.

The formulas include Blodgett's relation for the moment of inertia with a completely rigid solution for the computation of factor C_5. Additional expressions have been derived to facilitate conversion from ordinary dimensions to the geometrical ratios on which all the relations are based. Use of the formulas has been greatly simplified by extensive calculations giving numerical values for the complex factors contained in the formulas. The factors are shown as curves.

Corrugations used for roofing, siding, and drainage conduits are mostly of the arc-and-tangent type shown in Fig. 1. The cross-sectional contour of such corrugations can be represented by two parallel rows of evenly spaced and opposed arcs connected by tangents. This contour cannot be expressed by a single continuous mathematical formula. Such discontinuity necessitates determination of section properties by parts of the cross-section. H. B. Blodgett did this in 1934 for the moment of inertia of the arc-and-tangent corrugation using two non-dimensional parameters (CIVIL ENGINEERING, Sept. 1934). He used the pitch-depth ratio K for one parameter and the radius-depth ratio q for the other (Eqs. 1 and 2 respectively), to obtain the generalized expression for moment of inertia in Eq. 3.

$$K = p/d \quad \ldots\ldots\ldots\ldots \quad (1)$$

$$q = r/d. \quad \ldots\ldots\ldots\ldots \quad (2)$$

$$I = C_5 bt^3 + C_6 bd^2q \quad \ldots\ldots \quad (3)$$

Equation 3 contains the dimensional terms b, t, and d for corrugated width, sheet thickness, and corrugation depth respectively.

Factor curves in this paper are plotted with pitch-depth ratio as the independent variable at various web angles. Moment of inertia factors C_5 and C_6 are shown in Figs. 2 and 3 with Eqs. 4 and 5 respectively, on which they were based.

Equations 4 and 5, as well as Eqs. 6, 7, and 8 (which appear with Figs. 4, 5, and 6 respectively), are expressed in terms of trigonometric functions of the web angle α and the ratios K and q. Since these quantities are based on dimensions measured to the mid-thickness of the corrugated sheet, they define form regardless of sheet thickness. The first term of Eq. 3 gives the moment of inertia about the mid-thickness and the second term about the mid-depth or neutral axis. Equations 3, 4, and 5 satisfy the boundary condition of a flat sheet if the Poisson effect is neglected. However, in most corrugated sheets it is the second term of Eq. 3 that is important because it varies as the square of the depth, and the first term becomes relatively negligible.

More extensive use of Blodgett's equations for the moment of inertia of corrugated sheets may have been hindered by lack of adequate means for converting from the usual dimensions of corrugated sheets to the web angle α, in terms of which Blodgett's moment of inertia factors C_5 and C_6 are given. Additional equations are presented here to facilitate conversion to the web angle α.

The curves and the equations from which they were calculated are shown in Figs. 4, 5, and 6 for ratio of flat to

corrugated width λ, ratio of radius to depth q, and ratio of tangent length to depth m/d respectively. All the curves shown were based on four-place tables of the factors computed by the writer for 1-deg steps of the web angle between 14 and 90 deg, and for 0.1 steps of the pitch-depth ratio between 0.1 and 10.0. While the reduced curves given in this paper do not approach the accuracy possible by using the four-place tables, they make it possible to visualize the effects of pitch-depth ratio and web angle on the factors C_5, C_6, λ, r/d and m/d.

The following example shows how cross-sectional properties of a corrugated sheet can be determined from a given set of dimensions. It is always necessary to know t, p, and d, and one other of the quantities α, λ, r, or m to determine the cross-sectional properties of the arc-and-tangent corrugation.

Let the corrugation shown in Fig. 1 have a pitch of 6 in., a depth of 2 in., an inside radius of $1^1/_8$ in., and a thickness of 0.135 in. (10-gage steel). The mid-thickness radius is then $1.125 + (0.135/2) = 1.192$ in. The r/d factor becomes $1.192/2.000 = 0.596$, while p/d is $6/2 = 3$. Use of these ratios in Fig. 5 gives a web angle of about 45 deg. Using $\alpha = 45$ deg and $p/d = 3$ gives $C_5 = 0.14$, $C_6 = 0.145$, $\lambda = 1.24$, and $m/d = 0.93$ in Figs. 2, 3, 4, 5, and 6 respectively. The average moment of inertia per inch of width is

$$\begin{aligned} I &= C_5 bt^3 + C_6 bd^2 t \\ &= (0.14 \times 1 \times 0.135^3) + (0.145 \times 1 \times 2^2 \times 0.135) \\ &= 0.00034 + 0.0783 = 0.0786 \text{ in.}^4 \end{aligned}$$

Average section modulus per inch of width is

$$\begin{aligned} S &= (2I) / (d + t) \\ &= (2 \times 0.0786) / (2 + 0.135) \\ &= 0.0736 \text{ in.}^3 \end{aligned}$$

Average cross-sectional area per inch of width is

$$A = \lambda bt = 1.24 \times 1 \times 0.135 = 0.167 \text{ in.}^2$$

Average radius of gyration is

$$\rho = \sqrt{I/A} = \sqrt{0.0786/0.167} = 0.686 \text{ in.}$$

Length of tangent is

$$d \times (m/d) = 2 \times 0.93 = 1.86 \text{ in.}$$

I, S, and A for a corrugated width b are obtained by multiplying the average values of these quantities per inch of width by the corrugated width in inches.

Although this example was selected with steel in mind, the methods are equally suitable for other materials.

Cross-sectional properties of circle-arc and of triangular corrugations can be determined by using the factor curves directly, since these shapes are special cases of the arc-and-tangent corrugation and define its boundaries. Those corrugations with outlines suggesting rectangles and trapezoids, and with corner radii connecting the straight elements, can also be calculated using the factors for the arc-and-tangent corrugation by modifying the method. This is done by computing the properties of the flat crests and adding them to the properties of a hypothetical arc-and-tangent corrugation resulting from letting the flat crests vanish to zero.

Although these curves can be used to calculate any possible combination of arc-and-tangent corrugation dimensions, there is a minimum thickness for each corrugation below which local buckling and failure may occur.

The writer acknowledges the aid given him by Prof. H. B. Blodgett, M. ASCE, by providing in 1941 his basic steps for the moment of inertia of the arc-and-tangent corrugation.

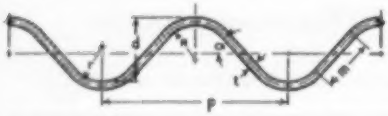


FIG. 1. Cross section of typical arc-and-tangent corrugation gives symbols used.

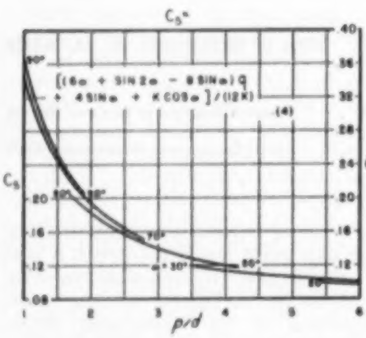


FIG. 2. Factor C_5 is plotted against pitch-depth ratio at various web angles.

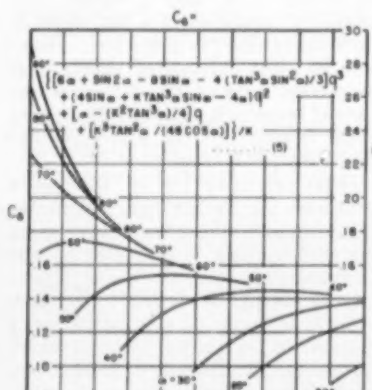


FIG. 3. Factor C_6 is plotted against pitch-depth ratio at various web angles.

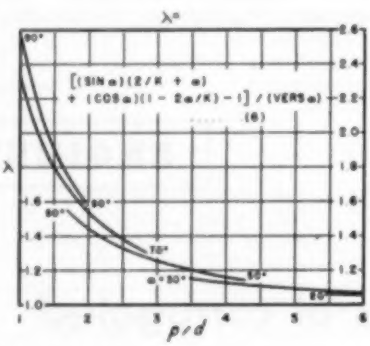


FIG. 4. Factor λ is plotted against pitch-depth ratio at various web angles.

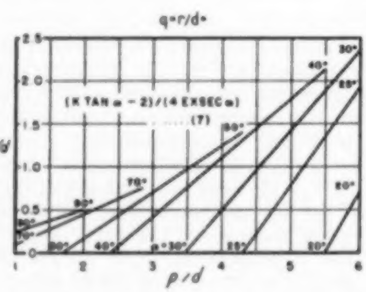


FIG. 5. Radius-depth ratio is plotted against pitch-depth ratio at various web angles.

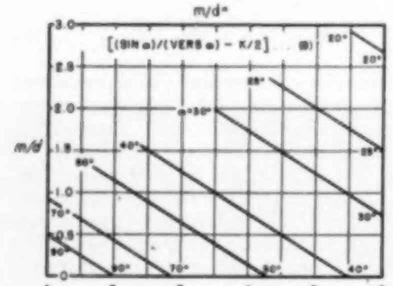


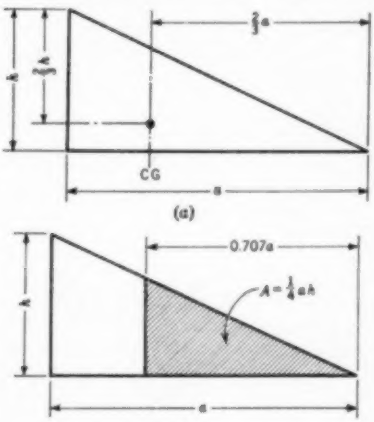
FIG. 6. Tangent-depth ratio is plotted against pitch-depth ratio at various web angles.

THE READERS WRITE

Stirrup spacing quickly found by slide rule

To the Editor: The following method, although not exact, is much simpler than that proposed by Jack Moyse in his article, "Stirrup Spacing in Beams Rapidly Determined," in the October issue, page 62. In the method here proposed, the stirrups, instead of being placed at the centroid of each area, are placed in the middle of the area. The results obtained are accurate enough for design purposes.

For example, in Fig. 1, in (a) the stirrups are placed at the centroid, and in (b) in the middle of the area. In (b), $\frac{1}{2}(x/a)h_x = \frac{1}{4}\,ah$; $x^2 = \frac{1}{2}a^2$; or $x = 0.707\,a$. This is close to $0.667\,a$, the result obtained by placing the stirrups at the center of gravity.



(a)

(b)

FIG. 1.

In the case of a trapezoid, the difference would be even less.

Assuming the shear triangle divided into N equal areas, the stirrups thus placed will divide the triangle into $2\,N$ equal areas (Fig. 2). The distance x from the right end

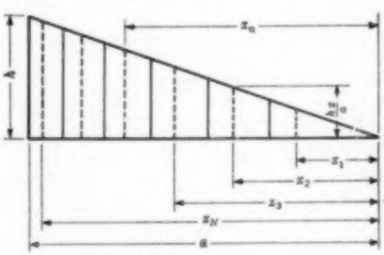


FIG. 2.

to any stirrup in the nth area (that is, any area chosen) will be:

$$\frac{1}{2}\frac{hx_n^2}{a} = \frac{2n-1}{2N}\frac{1}{2}ha$$

$$\text{or, } x = a\,\frac{\sqrt{2n-1}}{\sqrt{2\,N}}$$

Now if we divide a by the square root of $2\,N$ by setting a on the fundamental scale and $2\,N$ opposite on the square-root scale (the D and B scales respectively, on the K. & E. slide rule), when the odd numbered spaces, $2n - 1$, are read off on the B-scale, the difference between the corresponding values on the D-scale will be the stirrup spacing.

Proof:

Essentially what we have done is

$$\frac{a}{\sqrt{2\,N}} = \frac{x_n}{n}, \text{ a constant}$$

By reading off the odd intervals, we have

$$\frac{a}{\sqrt{2\,N}} = \frac{x}{\sqrt{2n-1}} \quad\text{or } x = a\,\frac{\sqrt{2n-1}}{\sqrt{2\,N}}$$

and generally

$$\frac{a}{\sqrt{2\,N}} = x_1 = \frac{x_2}{\sqrt{3}} = \frac{x_4}{\sqrt{7}} \;\ldots\ldots = \frac{x_n}{\sqrt{2n-1}}$$

The actual spacing is x_1; $x_2 - x_1$; $x_3 - x_2$; . . . . $a - x_N$ or simply the numerical difference between the values read off on the D-scale. This result can also be applied to a trapezoidal shear diagram by extending the diagram until it assumes the shape of a triangle. The stirrups are then spaced inside the desired area.

As an example, using what may be called the "slide-rule spacing method," see Fig. 3.

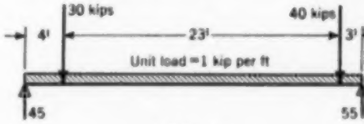


FIG. 3.

Designing at the left end, b = 12 in.; d = 32 in. (by the A.C.I. code, July 25, 1951). The shear in concrete, V_c, is

$$V_c = 90\,(12)\,0.866\,(32) = 30 \text{ kips}$$

Using $^3/_8$-in. round stirrups, $A_v = 0.22$; f_v = 20,000 = N, or number of stirrups needed.

In Fig. 4, let V_s be the shear taken by the stirrups, and

$$N = \frac{\text{Area of shear diagram}}{A_v f_v jd}$$

$$N = \frac{15\,(15)\,12\,(1{,}000)}{2\,(0.22)\,20{,}000\,(0.866)\,32} = 12$$

Set 180 in. on the D-scale and 24 in. on the B-scale.

B:	24	– 23	– 21	– 19	– 17	– 15	– 13	– 12	– 11	– 9	
D:	180	176	169	160	152	142	133	122	111	97	. . . .
	4 in.	7 in.	9 in.	8 in.	10 in.	9 in.	11 in.	11 in.	14 in.		

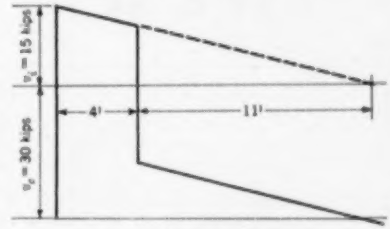


FIG. 4.

Space the stirrups as follows: 1 at 4 in. and 6 at 8 in. on centers.

Robert A. Hoff
Graduate Student, Univ. of Minn.
Minneapolis, Minn.

Equation for stirrup spacing corrected

To the Editor: Several correspondents have directed my attention to an error in my article "Stirrup Spacing in Beams Rapidly Determined," in the October issue. The equation for c (page 63), which read, $\frac{0.343}{0.22} = 0.13$, should have read $\frac{0.343}{0.22} \times \frac{1}{12} = 0.13$.

The complete equation is

$$\frac{(6{,}000)}{(f_v j)} \times \frac{1}{12\,A_v} = \frac{6{,}000}{20{,}000} \times \frac{8}{7} \times \frac{1}{12\,A_v} = \frac{0.343}{0.22} \times \frac{1}{12} = 0.13$$

Jack Moyse
Consulting Engineer
Louisville, Ky.

Boston Artery designed by two firms jointly

To the Editor: In the item on the Boston Aerial Highway in the December issue (page 86), the statement on the designers of this artery in the last sentence is incorrect. Actually the artery was designed by Charles A. Maguire & Associates and Fay, Spofford & Thorndike, retained jointly as consultants by the Massachusetts Department of Public Works.

Incidentally, the structure is more commonly referred to as the Boston Central Artery.

C. A. Farwell, M. ASCE
Fay, Spofford & Thorndike
Engineers
Boston, Mass.

SOCIETY NEWS

With successful conduct of the ASCE Atlanta Convention its primary project for 1954, the Georgia Section is adding final touches to a program (see the January issue) that will appeal to a variety of technical interests and social tastes. On the agenda for the Convention, which will be at the Atlanta Biltmore, February 17–19, are a Conference of Local Sections in the Southeast (with others welcome) on Monday and Tuesday of meeting week; a general business meeting of the Society on Wednesday, the 17th; a Welcoming Luncheon on Wednesday, with Gov. Herman E. Talmadge, of Georgia, the speaker; an "Icebreaker Party" on Wednesday evening; a Convention Luncheon on Thursday, with President Terrell the speaker; an inspection trip to the Buford Dam project Thursday afternoon; a dinner-dance Thursday evening; Sanitary and Hydraulics Division luncheons on Friday; and a Student Chapter Conference, with technical sessions, a luncheon, and dinner dance on Friday, and a tour of Southern Railway facilities in the Atlanta area on Saturday. In the daytime, the ladies will be off on their own, enjoying a program of sightseeing, luncheons, teas, and style shows, and evenings they will join the men for the "Icebreaker Party" and the dinner dance. There is still time to plan to go, and a card to Jack Carney, Chairman of Hotel Reservations, at the Atlanta Biltmore, will reserve a room. Moses E. Cox is general Convention chairman.

Carl E. Beam Retires From ASCE Staff

On January 15 Carl E. Beam retired as Assistant to the Secretary of ASCE and Manager of Civil Engineering after many years on the Society's staff. A graduate of the University of Washington, class of 1914, Mr. Beam was engaged on irrigation projects in eastern Washington, saw Army service in World War I, and was assistant chief engineer for the Washington State Reclamation Service before joining the ASCE headquarters staff as a technical editor in 1921. Later he became Assistant Secretary of the Society, in charge of Technical Division administration, meetings, and numerous other phases of Society activity.

In May 1941, Mr. Beam was called to active duty as a lieutenant commander in the Navy's Bureau of Yards and Docks in Washington, D.C. During his four and a half years of service, he was a member of the Bureau's Board of Contract Awards and rose to the rank of captain. As Assistant to the Secretary of ASCE and Manager of Civil Engineering since his return to the headquarters staff early in 1946, Mr. Beam has been instrumental in modernizing and improving Civil Engineering and in expanding its advertising. He was active in organizing the employees' retirement system and has represented the employees on the retirement committee since its inception. He has also represented the Society in its cooperative activities with the Associated General Contractors of America, Inc., and has supervised publication of a number of ASCE manuals, including Manual 29 on Professional Practice for Civil Engineers. More recently he has been engaged on a Manual on Cost Control and Accounting for Civil Engineers.

Mr. Beam became an Associate Member of ASCE in 1918, and a Member in 1928. In his retirement he has the good wishes of the many friends he has made in his work.

Carl E. Beam

ASCE Pipeline Committee Schedules Conference

Pipeline construction and operation will be the theme of a general two-day conference sponsored by ASCE. The conference will be a part of the spring meeting of the Texas Section at Midland, Tex., on April 8 and 9. Arrangements are being made by the Pipeline Committee of the Society's Construction Division.

A detailed program of subjects and speakers will be given in the March issue of Civil Engineering. Extra dividends to those attending will be paid in the extensive plans for entertainment and trips being made by the Texas Section. All inquiries about the program or plans to attend should be addressed to J. B. Spangler, Secretary, Pipeline Committee, Transcontinental Gas Pipeline Corp., Houston, Tex.

New Membership Roster Must Be Requested

As announced in the January issue, the new ASCE Directory for 1954, containing a roster of membership, is currently available for mailing to members without charge. Copies are distributed automatically to officers of the Society and the Local Sections. All others must request their copies by means of the coupon provided in the January issue (page 123), which is to be filled in and mailed to Society Headquarters.

As in past years, the Official Register for 1954, containing information on ASCE organization, activities, and personnel, is being mailed to the entire membership.

Research in Structural Joint Design Reported

Availability of the Second Progress Report of the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation is announced by the Foundation. The current 44-page paper-bound pamphlet contains brief reports of eight project committees of the Council, concerning tests to determine the behavior and strength of rivets and of high-strength bolts in structural connections.

Free copies may be obtained from the American Institute of Steel Construction, 101 Park Avenue, New York, N.Y.; the Industrial Fasteners Institute, 3648 Euclid Avenue, Cleveland 15, Ohio; or the Association of American Railroads, 3140 South Federal Street, Chicago 16, Ill.

Sponsors of the Council, of which E. J. Ruble is chairman, are the American Institute of Steel Construction, Inc., American Iron and Steel Institute, American Society of Civil Engineers, Association of American Railroads, the Engineering Foundation, State of Illinois Division of Highways, University of Illinois, Industrial Fasteners Institute, Northwestern University, Purdue University, U. S. Bureau of Public Roads, and the University of Washington.

New England Sections Plan Regional Meeting

A New England Regional Conference of Local Sections will be held at Massachusetts Institute of Technology in Cambridge on Saturday, March 20, under sponsorship of the New England Council. Arrangements call for registration at 9:00 a.m.; a power session featuring a paper on water power in New England and two papers on the $50,000,000 Littleton Hydroelectric Development; luncheon at 12:30, with a talk by President Terrell; two afternoon technical sessions, with papers on foundation design on soft ground and on highway finance; cocktails (Dutch treat) at 4:30; and dinner at 5:15.

A Ladies Committee will be on hand to help the visiting ladies plan a trip to the New England Flower Show, visits to the various museums in the Boston area, or shopping trips. The ladies will join the men for early dinner at the M.I.T. Faculty Club. E. L. Cochrane, dean of engineering at M.I.T., will address the joint group on transportation.

Members of the four Local Sections in New England may make their reservations with their local secretaries. Interested members outside the New England area should make reservations with Ernest L. Spencer, Secretary, New England Council ASCE, Northeastern University, Boston, Mass. Hotel reservations should be made directly with the hotel—Statler, Kenmore, Parker House, Touraine, or Sheraton-Plaza.

1953 Index to "Civil Engineering" Ready

Members wishing to incorporate the Index to Volume 23 of Civil Engineering in their 1953 bound volumes may obtain copies without charge on request to Society headquarters. A postal card request will be adequate.

Single copies of the Index are sent to all subscribing libraries. Extra copies are available on request.

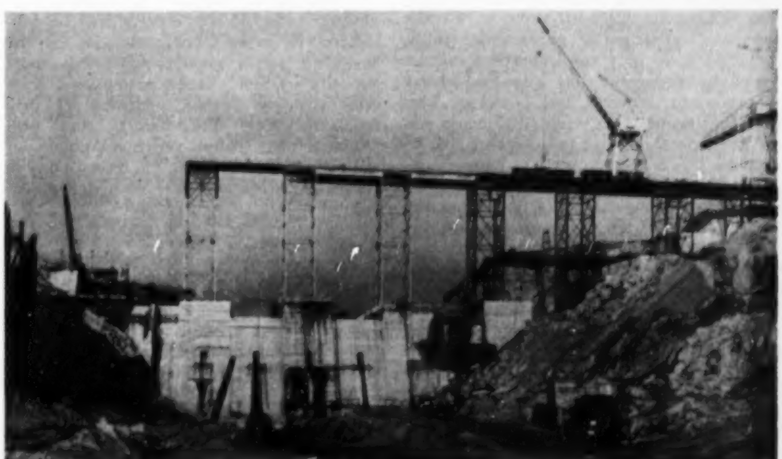
Pacific Southwest Conference Planned

Plans for the Seventh Annual Pacific Southwest Conference of Local Sections, to be held in Sacramento, April 28–May 1, are rapidly taking shape under the supervision of R. Robinson Rowe, general chairman. An expansion of the former California Conference, the Pacific Southwest Conference now includes the Arizona, Intermountain, and Hawaii Sections as well as the four California Sections (San Diego, Los Angeles, San Francisco, and Sacramento) originally constituting the conference. The Oregon Section has also accepted an invitation to take part in the conference.

The Program Committee, headed by Stewart Mitchell, was the first to get busy, and has already had many offers and suggestions for papers, particularly from the San Francisco, Los Angeles, Intermountain, and Oregon Sections, assuring an outstanding program of both technical and professional interest. Prominent on the program will be ASCE President Daniel V. Terrell.

Of special interest will be a field excursion to nearby Folsom Dam, a Corps of Engineers project on the American River. Placement of the concrete is now well along, and construction will be at an interesting stage at the time of the conference. A trip is also planned to Sacramento's new primary sewage treatment plant, to be completed in the summer of 1954.

Walter G. Schulz, of Sacramento, is chairman of the Conference Interim Committee, consisting of the 1953 presidents of the member Sections. Serving with him are Trent R. Dames, Los Angeles; Robert K. Fogg, San Diego; Clyde D. Gessel, Intermountain; H. C. Schwalen, Arizona; George D. Wallace, Hawaii; and J. G. Wright, San Francisco. J. C. Jennings heads the Publicity Committee, Room 207, City Hall, Sacramento, Calif.



Folsom Dam, a Corps of Engineers project on the American River in California, will be the objective of one of the field trips planned for the Pacific Southwest Conference of Sections, to which the Sacramento Section will be host April 28–May 1. This view (taken in December 1953) shows the construction trestle going into place.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE

Field Representative ASCE

The second session of the 83rd Congress opened on January 6 to begin what will be an epoch-making session if it can resolve a majority of the issues before it.

Problems Before Congress

So many fundamental problems of national and international significance require attention that the many proposals of specific interest to particular groups may not be solved. From the viewpoint of the professional engineer, the legislative issues may be considered in four general categories: (1) Broad national problems in which the engineer is interested as a citizen rather than specifically as an engineer; (2) reorganization problems involving departments interested in engineering and construction work; (3) bills relating to the general status of the engineer; and (4) specific detailed technical operations problems.

Matters coming under the first topic, dealing with Communism, international economic and political activity, national defense and taxation will take up much of the time of the legislators. Engineers, along with other citizens, have an interest in and will be affected by the measures enacted. The engineer will act through his other affiliations rather than through the Society to express his views in this broad field.

Reorganization problems, some of which directly affect the engineering profession, will receive consideration. Highway construction is coming to the fore as an issue that will require much attention to provide necessary expansion if automobile transportation is to play the important role in our national economy that is needed to keep the economy growing and healthy. The President proposes to retain, at 2 cents per gal, the federal gasoline tax, which is due to drop to $1^1/_2$ cents on April 1. Some proposals have been made for transferring the federal gas-taxing authority to the states and transferring much greater responsibilities in highway construction to them. Some of these proposals would seriously affect the position of the Bureau of Public Roads. The Society has a direct interest and an undoubted obligation to assist the Congress in resolving these problems.

The subject of water policy is still receiving attention in several quarters. The EJC Water Policy Panel is ably organized and geared to take an active part in advising on legislation involving water policy. This panel might well serve as a model for the engineering and related professions to use in dealing with other aspects of reorganization problems. Niagara Falls power, the St. Lawrence Seaway and the Hell's Canyon Dam are controversial topics that will be debated. The President strongly supports the St. Lawrence Seaway.

The Housing and Home Finance Agency will probably be overhauled. One of the principal interests of engineering and architectural societies has been in keeping the public works activities of this agency separate and distinct from other parts of its work. The engineering and architectural professions have felt that public works activities should not be under the Housing Agency at all, and that they should be kept entirely distinct so that they could readily be transferred elsewhere if the occasion arose. For many years, housing agencies have attempted to capture public works activities and at the present time moves are being attempted to consolidate them with other activities so that it would be difficult to separate them. It is possible that additional public works projects may be considered as an antidote to a business recession.

Measures Affecting Engineers

Several measures relating to the status of the engineer may come up for consideration. Amendments to the Taft-Hartley Act might involve such status in relation to collective-bargaining rights. The present provisions of the law relating to bargaining by professional employees will be supported by the engineering societies. No change in this provision was requested in the President's recent message.

Proposals to include professional engineers under Social Security will be considered, following recommendation by the President for a greatly expanded Social Security system. Some professional societies strongly oppose inclusion of professionals. One objection is that professional men seldom retire completely at the age of 65 and thus might have to pay in for many years and receive nothing from the system because of continued earnings.

Government employees, in general, hope for a salary boost and improvement in conditions. Sanitary engineers in the Army Medical Corps seek improved status. Legislation like the Reed-Keogh Bill to provide tax-assisted pension funds will receive consideration only if made a part of a general revenue bill. A bill to allow deductions for certain educational expenses of professional workers will be considered.

Certain operating problems are involved in proposed legislation as well as in Executive Department regulations. The Contract Renegotiation Law expired December 31, 1953. Its immediate renewal is being sought. Legislation is pending. Although the profession does not fully agree with the basic principles of a law providing for such a one-way revision of contracts, engineers are no more affected than others holding government contracts. An amendment proposing to raise the lower limit for renegotiation to $500,000 will be supported. Certain measures of interest to contractors—that is, the bill to regulate subcontracting practices, and the measure to provide court review on decisions of contracting officers—will be further considered continuing last year's consideration of these measures.

ASCE MEMBERSHIP AS OF JANUARY 8, 1954

Members	8,497
Associate Members	10,845
Junior Members	17,501
Affiliates	69
Honorary Members	43
Total	36,955
(January 9, 1953	33,755)

Bidding for Professional Services

Considerable progress has been made toward eliminating competitive bidding for professional services by agencies, and a further opportunity for improving the situation may develop in connection with current legislation. The laws relating to engaging professional services have been interpreted by some agencies in a manner unsatisfactory to the profession and contrary to the intent of the laws.

Another matter arising from time to time is the amount of fees permitted to consulting engineers. In major bills the profession attempts to have a reasonable maximum set, though occasionally some bill relating to, say, the Department of Agriculture may be found to contain a provision for a maximum of $25 a day for consulting services. Many of these incidental bills are not seen by this office. However, whenever such a matter comes to the attention of any Local Section or any member, this Field Office should be requested to assist in correcting it. This comment applies equally to any other engineering matter that seems improper in any bill.

The Administration Program

Several of the Presidential messages already given offer clues to the administration program. Other special messages will deal with Social Security, Housing, Grants in Aid, Highway Financing, Water Resources, and Public Lands Policy. The Budget message will translate the proposals of the other messages into proposals for dollars-and-cents activities.

Washington, D.C.
January 14, 1954

Report of ASCE Committee on Education Commended

The Board of Direction has approved the following report of the Society's Committee on Engineering Education, and each member of the Committee has received the Board's expression of appreciation for his excellent work on the report. The Board emphasized the obligation of practicing engineers and industry to employ engineering students during vacations.

Section A of the ASCE Committee's report indicates disapproval of several recommendations contained in the preliminary report of the American Society for Engineering Education's Committee on Evaluation of Engineering Education. A summary of the ASEE report, which was prepared by a 42-man committee headed by L. E. Grinter, M. ASCE, follows the ASCE committee report.

To the ASCE Board of Direction:

A. The ASCE Committee on Engineering Education is opposed to the preliminary report of the American Society for Engineering Education's Committee on Evaluation of Engineering Education with particular reference to parts of the report which recommend (1) the establishment of two types of curricula—*the professional-general*, and the *professional-scientific*—and (2) the use of a star or asterisk to indicate curricula which, in the opinion of the ECPD Education Committee, are being executed in a superior manner.

The committee is cognizant of the excellent work done by the ASEE Committee on Evaluation, but it feels that more attention must be paid to the views of those now engaged in the practice of civil engineering, those included in a broad segment of teachers of engineering, and those who utilize the services of engineers.

Although the ASEE report appears to over-emphasize the need for men with a highly scientific education, the need for more scientific training for a selected group is fully recognized by the committee. Suitable students should be encouraged to elect this type of program. It is the committee's opinion that many institutions in our country are adequately equipped now to offer more science and that much could be accomplished by a more liberal interpretation of the purpose of our present curricula or by the introduction of science options rather than by setting up new curricula.

The plan advocated by the ASEE Committee on Evaluation does not appear to be practical for the following reasons:

1. The committee is unable to see how the proposed plan could be carried out without an early choice by the student.
2. There would appear to be serious difficulty in changing from one type of curriculum to the other without loss of time.
3. The committee feels that such a plan would lead to the formalizing of two standards of collegiate training, and that these two standards would inevitably be recognized by the public as at two levels.
4. Many institutions would be forced to provide both types of curricula with serious resulting complications.
5. Administration would be a most difficult problem.

RECOMMENDATION "A": The committee believes that the recommendations referred to in the first paragraph of this report should not be put into effect without further study and a thorough examination of how they may affect the future of the profession. Since the committee is in favor of raising the standards of instruction in all our engineering schools, it suggests that the representatives of this Society on ECPD be asked to consider ways of raising standards without (1) setting up *professional-general* and *professional-scientific* curricula and without (2) using a starred list.

B. The committee has reconsidered Recommendation No. III of its own 1952–1953 report, which reads as follows:

"The committee strongly recommends that the members of the American Society of Civil Engineers, collectively and individually, take a more active interest in the education of young engineers. Since the work in college at the B.S. degree level is placing more emphasis on the basic courses and less on the applied courses, the need for postgraduate work becomes greater as time goes on. Since formal education is becoming less attractive because of high starting salaries after the B.S. degree, and postgraduate work is becoming more costly, the education of engineers at the higher level is suffering and will probably continue to suffer. It is therefore suggested that this expressed active interest, as recommended above, be expressed by establishing scholarships and fellowships, and by providing suitable summer jobs for students and young faculty members.

"The committee is also concerned about the development of exceptional men for research and teaching; hence it further suggests that means be studied for educating a few such men through the doctorate level, even to the extent of completely financing such education."

RECOMMENDATION "B": The committee reemphasizes the necessity for giving this recommendation further consideration.

The committee realizes the difficulty of carrying out the recommendation without giving tangible evidence of possible sources of funds. For example, attention is called to the desirability of continuing and advancing the training programs of certain of the railroads, and to the funds made available by the Bureau of Public Roads and several of the states, which, by law, must be spent for research. The present difficulty caused by the shortage of trained personnel could be improved by the employment of young engineers, under proper guidance, in research activities for the betterment of the public roads program.

Sister branches of engineering, particularly electrical and chemical, working through the major industries, have done much for their younger members. Civil Engineers should not lag too far behind.

Since it is quite unrealistic to expect an inexperienced man to fill a position which demands a background of previous training, employers of civil engineers should be planning on the future.

Giving summer employment to students and faculty members is a tangible means of manifesting interest in the objectives of the engineering profession.

RECOMMENDATION "C": The committee recommends that further consideration be given to Recommendation No. IV of its 1952–1953 report, which reads as follows:

"The committee recommends to the Board of Direction that the American Society of Civil Engineers take whatever steps are necessary and possible to modify the present method of selecting staff members in many engineering schools with particular reference to the practice of requiring that department heads have a doctor's degree and that other ranks have a master's.

"While the degree requirement may indicate achievement along some lines, it is no guarantee that the applicant can qualify as a successful teacher. Other factors should be considered such as practical experience, leadership, and ability to inspire youth. The committee feels that practical experience of a high order should be recognized as the equivalent of the doctor's degree."

Respectfully submitted:

W. S. Evans, Sr., *Chairman*
H. A. Williams
I. W. Santry
F. M. Dawson, *Contact Member*

1953 Committee on Engineering Education

October 18, 1953

Preliminary Report of ASEE Committee on Evaluation of Engineering Education Summarized

The ASEE Committee on Evaluation of Engineering Education was appointed in May 1952 by S. C. Hollister, M. ASCE, then president of the American Society for Engineering Education. The charge to the committee was to determine the pattern or patterns that engineering education should take to provide the leadership that the profession must have 25 years from now. The work of this committee over the past 18 months has been financed jointly by the Engineers Council for Professional Development and by the Engineering Foundation. The preliminary report [summarized below] is now being studied by institutional committees on evaluation in some 150 colleges of engineering. When the comments and criticisms from the educational institutions are received, the preliminary report will be revised and presented to the American Society for Engineering Education.

At the request of the ECPD Education Committee, which is responsible for recommending accreditation of engineering curricula, the preliminary report not only attempts to evaluate the factors that contribute to high quality in engineering education, but also offers for consideration several suggestions concerning the subject of accreditation. These suggestions have drawn considerable criticism from educational sources. Hence, it seems well to point out that the suggestions on accreditation have not been accepted finally by the Committee on Evaluation, but were presented to bring forth discussion and analysis by the engineering profession.

Of course, accreditation is the function of ECPD. Therefore, any discussion of accreditation by the ASEE Committee on Evaluation of Engineering Education can only be an expression of opinion, which is being clarified through the comments now being received. Educational recommendations from the final report (when accepted by the Council of ASEE) will be passed on to the colleges of engineering education.

L. E. Grinter, *Chairman*
ASEE Committee on Evaluation of Engineering Education

As examples of the increased importance of the basic sciences in engineering progress, one can point out that electronic developments have demanded greater knowledge of physics from electrical engineers. Such problems as continuity between structural members produced by welding and as the vibration of suspension bridges have demonstrated the need for greater scientific background for civil engineers. Mechanical engineers found new fields for research in heat transfer, fluid mechanics and, later, in jet and rocket propulsion. Practical metallurgy has changed from an art to a science based upon physical chemistry and physics of the solid state. The need for new reactor materials, new nuclear-thermal processes and new materials and systems for radiation protection add to our picture of the increasing influence of science upon engineering practice. The many developments of the past 10 to 15 years necessitate major changes in the character of engineering education.

From another direction there comes an even greater influence upon education in engineering. Since 1940 a large percentage of research physicists have had their interests reoriented toward nuclear problems, leaving engineers responsible for the continuity of research in all the other fields of engineering science. The leaders of the engineering profession 25 years hence must be engineers who are at no loss in interpreting, or themselves contributing to, extension of the fields of engineering science. Typical curricula of the 1910–1940 period were not designed with such an objective in mind.

Basic Science. The basic sciences for all engineering curricula include mathematics, physics, and chemistry. Mathematics through ordinary differential equations seems close to a minimum essential for all engineers. Chemistry deserves increased emphasis in engineering education, and for a larger proportion of engineers considerably more than the usual freshman chemistry course is necessary. The committee has on three occasions indicated its belief that modern physics, including nuclear and solid-state physics, has become an essential study in engineering. The committee, therefore, recommends greater emphasis upon basic science in engineering curricula.

Engineering Sciences. The committee has recognized nine important background sciences in engineering. They are statics; dynamics; strength of materials; fluid flow; thermodynamics; electrical circuits, fields and electronics; heat transfer; engineering materials; and physical metallurgy. All of these studies should be represented in curricula that train engineers for service in research, development or design, and probably no less than seven should be integrated into every curriculum that is represented as education for engineers.

Analysis, Design and Engineering Systems. In all curricula except those intended for training in management or other general professional service, studies in design, or in analysis leading to design, should occur as an integrated study over four successive semesters. Even the most general curricula should include such studies as a continuing program for at least two semesters.

Non-Departmental Engineering Courses. The committee affirms its conviction that the most important broadening courses in engineering, are those listed as the engineering sciences, such as electrical engineering for non-electricals and heat engines for non-mechanicals.

Humanistic-Social Studies. The committee recognizes the importance of social studies and the humanities as an important part of an engineer's education. Such studies reveal the richness of human experience so that students may in turn enrich their own lives. They should trace the political, economic, and social history of mankind to give students a clearer perspective of our civilization today. They should provide inspiration for seeking greater knowledge and understanding. They should aid the student to develop judgment and discrimination, a sense of value, and a sound personal philosophy.

Since a more scientific approach to engineering education is needed it will be essential to improve the scientific background of engineering faculties. An educational background which includes the Ph.D. degree is the strongest evidence usually available to measure the probable usefulness in teaching and research of a relatively young candidate for a faculty position. For older persons, evidence of the productivity of the individual in creative teaching and research may be gaged by other criteria, and the formal educational background is of less significance.

A faculty that can be expected to provide adequate leadership for students will have at least one member in five who has achieved professional distinction by creative activities. Such persons will (1) be conducting high-grade research of an engineering or educational nature or other creative activity including publishing of good quality, (2) be engaging in consulting work at a creative level, (3) be exercising leadership in scientific, educational, and professional societies, or (4) preferably be serving in a combination of such activities.

A request from ECPD brought the Committee on Evaluation into the discussion of accreditation. For proper handling of accreditation ECPD needs improved standards for measuring the effectiveness of the educational process and also criteria that distinguish engineering curricula from those in science and from those in technical institutes. The Committee on Evaluation concludes that a better background in mathematics, physics and chemistry, study of the previously mentioned nine engineering sciences, and continuing study of engineering analysis and design, or of engineering systems, extending through four semesters should distinguish an engineering curriculum intended for the training of engineers for professional-scientific service such as research, development or design. Then, recognizing the need for additional engineers for general professional engineering services, the committee concludes that a bifurcation in engineering education is

the practical answer to such diverging functional objectives. It has, therefore, devised the terms *professional-scientific* education and *professional-general* education to designate the two broad functional objectives of engineering education.

Professional-general education is that designed for producing engineers qualified (1) to serve in areas between engineering and business, management, law, real estate, or agriculture, (2) between engineering and a branch of science where the opportunities to apply engineering analysis and design may be limited, and (3) between engineering and a highly applied technology such as production processes, operation, construction, or air conditioning, welding, or wood technology.

To raise the standards of accreditation of engineering curricula without undue hardship, it is here recommended that the accreditation process be reconsidered on the basis of a distinction between *professional-scientific* and *professional-general* studies. Some institutions may choose one function or the other for all programs; others may make a division of the objectives selected by different departments, and in large departments dual curricula serving different functions may develop. The committee foresees difficulty in meeting within a four-year program its recommendations for an accredited professional-scientific engineering program plus all the specialized courses of the degree-granting department, but it believes that specialized engineering courses are of far less value in professional-scientific education than a broad background of engineering sciences and its application is one field of analysis and design.

In order that the decision to develop advanced standards of accreditation may not unduly restrict the number of possible accredited curricula, the committee recommends that a special designation be given to any curriculum taught by a faculty of unusual distinction where the program conducted by the faculty is of such a nature as to develop in a considerable proportion of the graduates a capacity for creative technical activity or creative leadership in engineering.

EMC to Work More Closely with National Manpower Group

Closer cooperation with the Scientific Manpower Commission will be an important 1954 objective of the Engineering Manpower Commission of Engineers Joint Council. In January, publication of the EMC Newsletter was discontinued in favor of a joint publication with the Scientific Manpower Commission, in the belief that such a publication will be a more economical and effective way of pursuing "basically similar programs on behalf of the engineering and scientific professions." An important joint function of the two groups will be that of catalyzing and coordinating activities "to the end that the recruitment, training, and utilization of engineers and scientists will be seen and handled as an integrated sequence of responsibilities with which the professional societies, industry, government and the public are vitally concerned."

As in 1953, the basic objectives of the Engineering Manpower Commission will include cooperation with industry, government, and private agencies in order to secure better utilization of engineers; provision of a clearing house of information for, and a channel of communication between, the profession, industry, the government, and others in the field; and maintaining an adequate flow of students into the engineering colleges through the promotion of interest in and knowledge of the work of the engineering profession.

In carrying out its program, EMC will maintain close contact with industry, the engineering colleges, and with such agencies as the Office of Defense Mobilization, the U. S. Office of Education, the National Research Council, the National Science Association, the Armed Services Committee of the Congress, the American Council on Education, the National Manpower Council of Columbia University and with manpower committees of other organizations.

T. H. Chilton will continue to serve as chairman of EMC during 1954, and T. A. Marshall, Jr., will again be executive secretary. M. M. Boring will be vice-chairman for the year.

New ECPD Report Issued

Availability of the 21st (1953) annual report of the Engineers Council for Professional Development is announced by L. F. Grant, chairman. The report states that considerable progress has been made in the past year in providing counseling for high school boys interested in entering engineering. Such counseling is now available in many schools in the United States and Canada. Ultimately, the report notes, it is hoped to extend the programs to every high school. In Cincinnati a training program for young engineers is functioning under the direction of Cornelius Wandmacher, A.M. ASCE, head of the department of civil engineering at the University of Cincinnati, with some 280 students currently attending night classes in engineering. The Committee on Student Development is directing its efforts to awakening university students to their professional responsibilities and the dignity of the profession.

Also included in the report are lists of accredited engineering curricula and accredited programs of the technical-institute type as well as the charter and rules of procedure, Canons of Ethics, Faith of the Engineer, and committee personnel.

Inquiries concerning the report should be addressed to the Engineers Council for Professional Development, 33 West 39th Street, New York 18, N.Y.

EJC Officers for 1954 Appointed

Thorndike Saville, M. ASCE, was named 1954 president of Engineers Joint Council at a meeting on January 15. ASCE Past-President Carlton S. Proctor will be vice-president. The member societies will be represented on the Executive Committee by the following: ASCE, Carlton S. Proctor (alternate, G. B. Earnest); AIME, W. M. Peirce (alternate, H. D. Smith); ASME, F. S. Blackall, Jr. (alternate, E. J. Kates); AWWA, C. H. Capen (alternate, H. E. Jordan); AIEE, W. J. Barrett (alternate M. D. Hooven); SNAME, L. R. Sanford (alternate, W. L. Green); ASEE, T. Saville (alternate, N. W. Dougherty); and AIChE, C. G. Kirkbride (alternate S. L. Tyler).

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

New **Alabama Section** officers, elected at the Section's two-day annual meeting in Mobile in December, are Wayne F. Palmer, president; Arthur S. Chase, first vice-president; Rudolf Landberg, second vice-president; and James M. Tuttle, secretary-treasurer. More than 200 engineers in the Deep South attended the meeting, which featured talks on Society business by ASCE President Daniel V. Terrell, Vice-President Edmund Friedman, and Director James A. Higgs; discussions on prestressed concrete by Prof. Walter Blessey, of Tulane University, and Wessel Panayotoff, of Palmer and Baker, Inc.; and an inspection trip through the Hollingsworth and Whitney pulp and paper plant. A highlight of the annual banquet was the presentation of life membership certificates to James H. Childs, of Auburn, and J. Wallace Johnston and Richard B. Shepard, Jr., both of Birmingham. The after-dinner speaker was J. B. Converse, of Mobile, with a talk on "Europe Through an Engineer's Eyes."

The **Arizona Section** is giving study to ways of expanding and inviting the comment of members. Quarterly meetings have been suggested instead of the present semiannual meetings. In November the first of a series of meetings sponsored by the University of Arizona Student Chapter and attended by Section members in the Tucson area was initiated.

The question of the need for specialty boards for certification of specialists in various engineering fields was thoroughly aired by W. H. Wisely, of Champaign, at a meeting of the **Central Illinois Section** in Urbana on December 1. In his talk Mr. Wisely, who is executive secretary and editor of the Federation of Sewage and Industrial Wastes Associations, also discussed the objectives and actions of the proposed American Institute of Sanitary Engineers. J. J. Doland, professor of hydraulic engineering at the University of Illinois, received his certificate of life membership at the meeting, and the Section officers for 1954 were announced. The officers are W. A. Oliver, president; W. E. Hanson, first vice-president; R. B. Peck, second vice-president; and W. H. Munse, secretary-treasurer.

New officers for the **Central Ohio Section**, installed at the Section's annual meeting and Ladies' Night on December 10, are L. D. Harrison, president; R. K. Morris, first vice-president; Thomas W. Singell, second vice-president; and Charles B. Smith, secretary-treasurer. Ohio's water problems were discussed by Robert C. Smith, chief geologist for the Ohio Division of Water, and a film, "Pipeline to the Sky," was shown.

Modern methods and equipment used in surveying were reviewed by Prof. Robert T. Howe, of the University of Cincinnati, in the leading talk at the **Cincinnati Section's** December meeting. The tremendous postwar progress in the field, especially in electronic equipment developments, was excitingly described by Professor Howe, who illustrated his talk with an opaque projector and exhibits of the equipment itself. A picture of recent activities of the Board of Direction was given by ASCE Director Warren W. Parks.

Members of the **Duluth Section** heard Dr. Darland, provost of the Duluth Branch of the University of Minnesota, speak on the construction background of the new physical education building on the college campus at the November meeting. The newly organized **Iron Range Subsection** featured a talk on underground water supplies by Fred Voedich, of the Layne-Minnesota Co., at its November meeting.

J. G. Wright, 1953 president of San Francisco Section, and Past-President Walter Huber beam over a sterling silver punch bowl, given Mr. Huber by the Section at its annual meeting "in recognition of his outstanding service as President of ASCE in 1953." The technical program featured a talk by Ralph A. Tudor, Undersecretary of the Interior, who discussed the reorganization of the department.

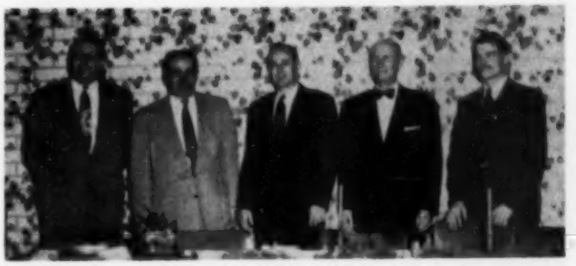
New and outgoing officers of the Los Angeles Section are photographed at recent meeting. Shown, in usual order, are S. B. Barnes, outgoing vice-president; Gilbert Outland, treasurer for 1954; Walter Hollingworth, incoming vice-president; Sterling S. Green, president, C. M. Duke, who will complete a two-year term as secretary in 1954; Trent R. Dames, retiring president; and J. S. Server, retiring vice-president.

Both the **Florida Section** and the **Jacksonville Subsection** elected new officers at their annual joint meeting and banquet in Jacksonville on December 8. A. O. Patterson, of Ocala, becomes president of the Section, and Jack O'Brien, of St. Petersburg, vice-president. Byron D. Spangler, of Gainesville, was reelected secretary-treasurer. Subsection officers are Lewis Shields, president; John L. Clarke, Jr., vice-president; and Merle D. Geoffrion, secretary-treasurer.

President Daniel Terrell and other Society officers addressed the **Georgia Section's** all-day annual meeting in Atlanta on December 5, which included a technical session, a reception and social hour with Mr. and Mrs. Warren S. Mann as hosts, and a dinner dance. New Section officers, installed during the dinner, are C. E. Drummond, Jr., president; J. B. Wilson, vice-president; and John Money, vice-president-at-large. Burton J. Bell was reelected secretary-treasurer for a two-year term.

Presentation of certificates of life membership in ASCE was a feature of the **Intermountain Section's** annual meeting, held in Salt Lake City on December 17. Clyde Gessel was also honored—with the gift of a Society lapel button and words of praise—for the year he has just completed

Lehigh Valley Section officers are shown with Earl E. Schaffer (second from left) mayor of Bethlehem, Pa., and principal speaker at the Section's December meeting in Bethlehem. Mr. Schaffer outlined the city's projected building program, including enlargement of the water supply and street expansion and improvement, to be completed in 1958. Reading, left to right, are Vice-President R. E. Kolm, Mayor Schaffer, Vice-President John McNeal, III, President Bernard Smith, and Secretary-Treasurer E. K. Mulhausen.



as Section president. Grant K. Borg is the 1954 Section president, and Harold W. Chase, the new vice-president.

Public health and other engineering problems arising in the handling of radioactive materials were explored at a joint meeting of the **Iowa Section** and the Iowa State College Student Chapter held at the college on December 2. The speaker was Milo Voss, health physicist for the Atomic Research Institute at Ames.

"The Horizon of Science in Industry" was the subject of the featured talk at the **Ithaca Section's** December dinner meeting, which was held at Elmira, N.Y., and attended by 140 members of the Steuben area sections of four engineering societies as well as by Section members. The talk was given by Lawrence A. Hyland, vice-president in charge of engineering for the Bendix Aviation Corp.

The **Los Angeles Section** has formed a new Branch, which will be called the **Desert Area Branch** and will meet at China Lake, Calif. At an organizational meeting on November 13, the following officers were elected for the new group: Martin J. Snow, of China Lake, president; Wells O. Abbott, Independence, vice-president; and Irwin I. Shull, China Lake, secretary-treasurer.

At its November meeting the recently formed **Shreveport Subsection** of the **Louisiana Section** discussed the type of program it can successfully carry out and other matters of operation. Its 1954 officers, unanimously elected at the meeting, are: W. C. Sorensen, president; Francis W. Grant, first vice-president; Thomas F. Quinn, second vice-president; Val A. Lyons, secretary; and Robert E. Gregory, treasurer.

There was a large turnout of **Metropolitan Section** members for the Section's second meeting of the season, on December 16, with precast concrete the drawing card. Charles S. Whitney, partner in the New York consulting firm of Ammann & Whitney, acted as moderator of a panel discussion that placed emphasis on the economy of the method and on "the higher quality of concrete that can be expected on a precast design." Taking part were experts Roger Corbetta, president of the Corbetta Construction Co.; K. P. Billner, president of the American Branch of Vacuum Concrete, Inc.; and A. Gordon Lorimer, of Lorimer & Rose. The **Junior Branch** is arranging another P. E. Refresher Course, to begin early in March in preparation for the June 1954 examination. The subjects of Economics and Practice, Hydraulics and Sanitary Engineering, Surveying and Structures will be reviewed in eleven sessions. More information is available in the Section's January *Newsletter* or from Prof. Milton Alpern, the Civil Engineering Department, Cooper Union, Cooper Square, New York 3, N.Y.

Engineering wonders of the **Mid-South Section** area, selected at the Section's annual meeting at Jackson, Miss., December 10–12, are: (1) the Lower Mississippi River Control System of Levees, Bank Stabilization, and Channel Cutoffs; (2) the Yazoo River Headwater Reservoir System; (3) the Crump Bridge over the Mississippi at Memphis, Tenn.; (4) the Bull Shoals Dam and Reservoir Project in Arkansas; (5) the Arkansas Livestock Show Coliseum at Little Rock; (6) the Thermo-electric Power Station at Cleveland, Miss.; and (7) the Reynolds Metal Company's New Aluminum Plant at Gum Springs, Ark. Featured on the technical program were three excellent student papers representing three Mid-South Chapters—"Investigation of Cold-Mix Asphaltic Concrete Materials," C. R. Ogden, University of Arkansas; "A Method of Determining the Air Content of Soils," John B. McKee, Mississippi State College; and "Plant Engineering in Construction," G. P. Johnson, University of Mississippi. Featured luncheon meeting speaker was ASCE Director E. W. Carlton who discussed the Society's present financial status, problems and possible solutions. The Section's new officers are: S. W. Chandler, Jackson, president; A. W. Hardy, Little Rock, vice-president; and E. C. Meserve, Little Rock, secretary-treasurer.

Six civil engineers in the **Mohawk-Hudson Section** were given their life membership certificates at the Section's annual meeting held at Union College on December 9. Honored were Maj. Gen. Edmund L. Daley, Col. Lyman R. Talbot, Ernest L. Robinson,

Prominent on the technical program for the Fourth Annual Maine Highway Conference, sponsored by the Maine Section in December, are speakers representing the Maine and New Hampshire Highway Departments. Shown, left to right, are Sylvester L. Poor and Vinton A. Savage (Maine) and Richard A. Brunel and Donald Roach (New Hampshire). Consensus of the panel, which reviewed past methods of pavement design and the use being made of preliminary investigations in current design, was that adequate preliminary studies mean better highways at less cost. Ernest Sutton, a civil engineering student at the university, was awarded a $25 prize for the best student paper presented annually by the New England Road Builders Association, and Mr. Brunel received the Maine Good Roads Association's prize of $25 for his paper on "Highway Design in New Hampshire." The registered attendance of 169, highest of any conference to date, included 56 students.

J. C. Stevens (left), of Portland, receives a plaque for his services to the Society as President in 1945 at a meeting of the Oregon Section. With him are Ben S. Morrow (center) a lifetime friend and water engineer for the City of Portland, and H. Loren Thompson, president of the Oregon Section. Mr. Stevens was prevented by illness from attending the presentation ceremonies at the Past-Presidents' dinner in New York in October, when the other Past-Presidents received plaques.

Edward G. Semon, John C. Brigham, and Charles M. Madden. Election of new officers resulted in the selection of George W. McAlpin, president; J. Sterling Kinney, vice-president; Herbert J. Johnson, secretary; and Holbert W. Fear, treasurer. The speaker of the evening was Nelson Wells, state landscape architect, who talked about the esthetic treatment of highways in general and of the New York State Thruway in particular.

The **Nebraska Section's** annual meeting, held at Lincoln on December 8, was given over to the election of new officers and presentation of certificates of life membership. Douglas D. Lewis is president, George R. Bathe, senior vice-president; and George C. Ernst, junior vice-president. The certificates went to David L. Erickson, Roy M. Green, John Latenser, Jr., William J. Provaznik, Clifford Shoemaker, and Guy M. Williams.

The **Oklahoma Section** was host to the ASCE Executive Committee for its meeting in Oklahoma City on January 8. At the close of its all-day session the Committee met with the Section, which was also host to local groups of the other EJC societies in the state. The joint group heard M. B. Cunningham, president of the American Water Works Association, speak on "Resources for the Future." The Executive Committee constituted itself a panel to answer all questions from the floor, and a lively discussion on collective bargaining for engineers and the unity of the profession followed.

In a talk on underpinning and shoring work, given at the **Providence Section's** December meeting, Charles B. Spencer described such well known jobs as the reconstruction of the White House, work on the Leaning Tower of Pisa, and relocation of a monastery in Quebec. Mr. Spencer is president of Spencer, White & Prentis, New York Foundation specialists.

The current planning status of the Feather River Project—a proposed $1.6 billion project that would bring water from the Feather River discharge point in the San Francisco Bay region southward to San Diego County—was described at the **San Diego Section's** December meeting by Max Bookman, senior engineer for the Southern Division of the project. The project would involve carrying water approximately 570 miles, and pump lift would be from sea level to an elevation of about 3,000 ft. Estimated cost of the water delivered to San Diego would be $50 per acre-ft. George Edwards, first-place winner in the recent student paper contest at San Diego State College, was introduced to the Section and given its check for $25.

Edwin E. Rippstein was elected president of the **St. Louis Section** at its annual meeting in December. Also chosen were Clarence H. Ax and Charles F. MacNish, vice-presidents; Robert A. Smith, secretary; and Lawrence P. Roth, treasurer. ASCE Director E. W. Carlton discussed the Society's plans for the coming year and gave certificates of life membership to Harland Bartholomew and Harry Rubey. To stimulate attendance of Junior Members at the dance that concluded the evening the Section provided free guest tickets for wives or dates.

Engineering aspects of construction in Korea were discussed at the November 24 meeting of the **Tri-City Section,** with Robert Seibert, of Galesburg, Ill., the principal speaker. Mr. Seibert was attached to the Corps of Engineers during the Korean War. New Tri-City officers, elected at the meeting, are L. A. Carlson, president; L. S. Pappmeier, vice-president; and R. F. Erickson, secretary-treasurer.

Coming Events

Central Ohio—Meeting at the Ohio Union, Columbus, February 18, 6:30 p.m.

Delaware—Meeting at Hanna's Restaurant, Wilmington, Del., on February 16.

Hawaii—All-day meeting program consisting of breakfast, technical session, luncheon and dinner dance, at the Queen's Surf, Honolulu, on March 1. For reservations write to Mr. Donald S. Austin, Convention Chairman, Austin and Towill, Civil Engineers, 205 Merchant St., Honolulu.

Metropolitan—Meeting in the Auditorium of the Engineering Societies Building, 33 West 39th St., New York, N.Y., on February 17, 7 p.m. Meeting of the Junior Branch in the ASCE Board Room on February 24, 7:30 p.m.

Miami—Joint meeting of member groups of the Engineers' Council of South Florida (substituted for regular March meeting) on February 25.

Los Angeles—Dinner meeting on February 10 (reservations to be made by calling Secretary Martin Duke at Bradshaw 2-6161 by February 8) followed by a talk in the Roger Young Auditorium. The Junior Forum will hold a meeting in the auditorium on the same date, starting at 6 p.m. The Junior Forum holds noon luncheons at downtown restaurants with the last luncheon of each month at the Engineers Club at the Biltmore Hotel (reservations through Chuck Gorham at Michigan 4211, Ext. 2410). The Section's Sanitary Group will hold a dinner meeting at the Taix French Restaurant, 321 E. Commercial St., February 24, 6:30 p.m.

Philadelphia—Joint meeting with the Central Pennsylvania Subsection and the newly-formed Trenton Subsection, at the Engineers' Club, Philadelphia, February 9, 7:30 p.m. Dinner at 6:00 p.m.

Syracuse—Meeting on March 17 to be addressed by President D. V. Terrell.

West Virginia—Meeting in conjunction with the Engineers Week celebration, in the State Capitol, Charleston, February 25, 8 p.m.

Scheduled ASCE Conventions

ATLANTA CONVENTION
Atlanta, Ga.
Hotel Biltmore
February 15–19, 1954

ATLANTIC CITY CONVENTION
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

NEW YORK CONVENTION
Hotel Statler
October 18–22
1954

NEWS BRIEFS . . .

ARBA Urges Bold Program to Improve Nation's Roads

The sea breezes of Atlantic City, N.J., were filled with words during the recent annual meeting of the American Road Builders Association, but one thought predominated—where to get the money required to finance the badly needed highway improvement program. The sessions and topics were many and varied, but the problem of finance permeated most discussions.

Robert M. Reindollar, reelected president of the ARBA, argued that a "bold, realistic national program of action to improve the country's highways is imperative." He stated that, "It is urgent that the federal government, in cooperation with the states, counties and communities, continue and expand its aid program in the general welfare."

Representative Fallon, democrat of Maryland and member of the House Committee on Public Works, endorsed as "plausible" the Association's proposal to treat the highway problem on a long-range basis.

Speaking of what lies ahead in the field of highway planning, Commissioner F. V. du Pont, of the Bureau of Public Roads, stated that "To concede for one moment that we have not the engineers, contractors, the manpower, the equipment, and the wherewithal to solve this problem, is in my judgment juvenile, pessimistic, and unrealistic. The only problem is to determine to what extent the federal government and the state governments should assume the responsibility, and this decision rests with the Congress and the administration."

Attacking the problems of highway costs, the Manufacturers and Contractors Division of the ARBA sponsored a symposium on road equipment. Presiding were Harald T. Reishus, vice-president of the International Harvester Co., and S. Howard S. Brown, president of Brown, Davis & White. In this symposium M. B. Garber, of the Thew Shovel Co., emphasized the necessity of projecting construction programs over longer periods, producing more stable markets for equipment manufacturers and, thereby, reducing prices of equipment.

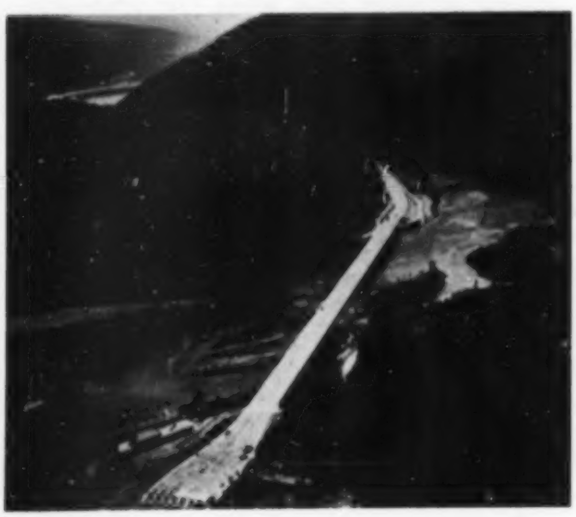
Charles W. Smith, of the Smith Engineering & Construction Co., another member of the panel, noted that the equipment market was again a buyer's market. He further pointed out that in today's highway construction two-thirds of the construction cost is invested in equipment, a significant fact when the cost of future highway programs is considered.

Steps being taken by the Corps of Engineers to develop new equipment were outlined by Col. C. T. Newton, chief of the Research and Development Division of the Office of the Chief of Engineers. Objectives of the program are reduction of spare parts, interchangeability of various manufacturers' lines, and ease and speed of maintenance. Many of the developments, Colonel Newton pointed out, find their way into non-military use. The fourth member of the panel, H. A. Radzikowski, of the U. S. Bureau of Public Roads, showed how the correlation of design and construction methods result in reduced design and construction costs while resulting in safer highways. He also outlined areas where maintenance equipment needs further development.

At the annual business meeting on Thursday, January 7, the present ARBA officers were reelected to office for the coming year. They are: Robert M. Reindollar, consulting engineer, Baltimore, president; Charles M. Noble, M. ASCE, vice-president, northeastern district; W. G. Pruett, vice-president, southern district; Julian R. Steelman, vice-president, central district; Harmer E. Davis, M. ASCE, vice-president, western district; and Jennings Randolph, assistant to the president, Capital Airlines, Inc., treasurer. Lt. Gen. Eugene Reybold, M. ASCE, former Chief of Army Engineers, is executive vice-president of the association.

International Harvester To Expand Its Line

Continuing its program to round out a full line of equipment in the industrial power and earthmoving industry, the International Harvester Co. has made an agreement with the Heil Co., of Milwaukee, Wis., which will enable it to manufacture two-wheel rubber-tired industrial tractors for use in heavy construction work. Two models of such tractors are currently being built by the Heil Co. and, in combination with either scrapers or wagons, marketed as "Heiliners." They will now be sold through Harvester's Industrial Power Division under the trade name of "International."



Bridge at Delaware Water Gap Is Opened to Traffic

This new four-lane bridge across the Delaware River at Delaware Water Gap, which will link the arterial highways of Pennsylvania and New Jersey, was officially opened to traffic on December 16 in ceremonies attended by the governors of the two states and other distinguished guests. Constructed by the Delaware River Joint Toll Bridge Commission at a cost of $8,276,000, the crossing is one of three which the Commission has completed in the upper Delaware Valley at a cost of $19,000,000. The other bridges connect Milford, Pa., and Montague, N.J., and Portland, Pa., and Columbia, N.J. The Bethlehem Steel Co. fabricated and erected nearly 8,500 tons of steel for the superstructures of the three bridges. The J. E. Greiner Co., of Baltimore, Md., were consulting engineers to the Joint Toll Bridge Commission, and Johnson, Drake and Piper, Inc., of New York, the prime contractors.

Labor Recommendations Affect Construction

In President Eisenhower's Labor Message to Congress, on January 11, he made a number of legislative recommendations affecting labor-management relations. Of special interest to engineers in the message, which seeks amendment to the Taft-Hartley Labor Law, are two recommendations that specifically apply to the construction industry.

In discussing the provisions of the act against secondary boycotts, the President recommended that the act be clarified by making it explicit that concerted action against (1) "an employer who is performing "farmed-out" work for the account of another employer whose employees are on strike or (2) an employer on a construction project who, together with other employers, is engaged in work on the site of the project, will not be treated as a secondary boycott."

Recognizing that "Employees engaged in the construction, amusement, and maritime industries have unique problems because their employment is usually casual, temporary, or intermittent," the President recommended that, in these industries, "the employer be permitted to enter into a pre-hire contract with a union, under which the union will be treated initially as the employees' representative for collective bargaining." He also recommended that, in these industries, "the employer and the union be permitted to make a union shop contract, under which an employee, within seven days after the beginning of his employment, shall become a member of the union."

Engineering Study of Jordan Valley Extended

Extension of the agreement between the Jordan government and the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), under which it was agreed to reserve $40,000,000 for the Yarmuk-Jordan Valley power and irrigation project pending the completion of engineering surveys, is announced. The original agreement, earmarking the funds, was signed in March 1953, and the funds were reserved until the end of the year, by which time it was expected the various projects for use of the funds would be determined. However, in view of the fact that the engineering surveys have taken longer than anticipated, the Jordan government has proposed that UNRWA extend the agreement for another six months, and the agency has agreed to the proposal.

The program provides for construction of a dam 400 ft high, across the Yarmuk River, which will feed two power stations, with a total capacity of 10,000 kw, and irrigate 95,000 acres in the Jordan Valley below the confluence of the Yarmuk-Jordan rivers and the Dead Sea. It is estimated that 20,000 refugee families may be rehabilitated by the project.

Causeway to Connect Nova Scotia and Cape Breton

A permanent connection for rail and highway traffic between the mainland of Nova Scotia and Cape Breton Island will be provided by a causeway, which is being built across the Strait of Canso for the Department of Transport of Canada and the Nova Scotia Department of Highways. Called the Canso Project, the causeway will eliminate two ferry lines across the Strait between Mulgrave and Port Hawkesbury, and will ultimately constitute the eastern terminus of the proposed Trans-Canada Highway.

The project involves three phases: a 13-mile Canadian National Railway diversion, under contract to the Modern Construction Co.; the construction of a lock system on the Cape Breton Island side, which is under contract to T. C. Gorman & Co.; and the construction of the causeway itself, under contract to the Northern Construction Co. and J. W. Stewart Ltd.

The causeway contract involves 3,000 ft of rock cut along the shore and 4,000 ft of rock fill over the strait. It will have a finished top width of 80 ft, with the fill spreading to a width of 650 ft at the point of maximum depth which is 200 ft. The total quantity of rock required is slightly over 9,000,000 tons. Both sides of the 4,000-ft section are riprapped with crane-placed rocks, starting from a shelf excavated 10 ft under water on one side and 5 ft on the other.

The granitic rock required is being quarried from nearby Cape Porcupine. To produce the large-size material specified for the fill and riprap, the coyote method of blasting is used. The rock is loaded into a fleet of ten 34-ton rear-dump Euclid trucks (Model 4FFD) and two 22-ton Model 8TD Euclid trucks by two 120B Bucyrus-Erie Electric Shovels and a $2^1/_2$-cu yd Lima Shovel. A 4500 Manitowoc is used as a dragline to excavate a shelf for the riprap and as a crane with a four-point Owen Rock Grab to place the riprap. Currently the water crossing is about 60 percent complete. The rock fill is scheduled for completion on December 31, 1954.

Design and inspection are under the direction of O. J. McCulloch & Co., of Montreal, consultants to the Department of Transport. They are represented on the job by H. MacKenzie, as resident engineer. W. M. Goodwin, project manager for the Northern Construction Co., supplied the material for this item.

Canso Causeway, connecting the Nova Scotia mainland with Cape Breton Island and involving 3,000 ft of rock cut along the shore and 4,000 ft of rockfill over the strait, is about 60 percent finished. Completion of the fill is scheduled for December 31, 1954. Location of the project is shown on the map.

Big Machines Speed Work on AEC Portsmouth Plant

Fill is prepared for building sites at the mammoth new Portsmouth, Ohio, gaseous diffusion plant of the Atomic Energy Commission by a team of big machines, which mix soil and rock in predetermined proportions. A Caterpillar D-8 Tractor, pulling a Wood Aggregate Mixer, handles 9,000 cu yd per 9-hr shift while moving at a speed of only $1^1/_2$ mph. Peter Kiewit Sons' Co. has the construction contract on this $1.2 billion plant, which was started in 1952 and is expected to require about four years for completion. Giffels & Vallet, Inc., are handling the structural design. When completed, the plant will be operated by the Goodyear Atomic Corp., a subsidiary of the Goodyear Tire & Rubber Co.

AEC Sphere Readied for Testing Sub Prototype

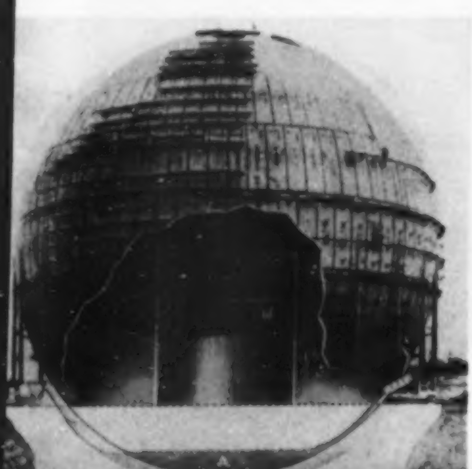
The unique project of anchoring a 20-story-high hollow steel sphere and readying it to house an atomic reactor is being completed by the Rust Engineering Co., of Pittsburgh, for the Atomic Energy Commission on a site near Schenectady, N.Y. Like an egg in an egg cup, the giant 225-ft sphere is designed to nestle in its foundation some 38 ft below ground level. Inside it was filled to slightly above ground level to provide floor space, ballast, and foundation support for the landlocked prototype of the Submarine Intermediate Reactor (SIR) for the Navy's *Sea Wolf*. Identified as SIR Mark A, the project is under the direction of the Knolls Atomic Power Laboratory at Schenectady, N.Y., which is operated for the AEC by the General Electric Co.

Originally the 3,850-ton steel sphere was suspended some 4 ft above the concrete saucer foundation, which is supported at its equator by a ring of 26 columns. Filled, its weight is distributed between the foundation and the columns. The huge ball was suspended above its bed to allow for working and testing during construction.

The problem faced by Rust engineers was to pour a 3,900-cu yd cushion of concrete beneath the hollow ball and 28,000 tons of limestone fill inside it without setting up stresses that might break its 1-in. skin or distort its shape. As a solution to the problem, engineers poured a 3-ft layer of limestone inside one day and a 3-ft layer of concrete outside the next, allowing neither material to rise more than 18 in. above the level of the other. A chute that revolved around the globe's axis like the hands of a clock, was devised to pour concrete in building up the foundation, which has a diameter of 179 ft at ground level.

All fill and structural material were brought into the sphere through a single opening. Later the opening will be sealed, and entry effected through two airlock entrances. The limestone fill inside the globe, composed of crushed screening 1 in. and under, was compacted to a relative density of 95 percent. As the fill rose in the globe, layer by layer, mechanical handling was required to spread it evenly over an ever-growing area that at floor level comprises 22,000 sq ft. The fill will be topped with a concrete floor, which will be 3 ft thick under the nuclear reactor. The reactor will be enclosed in a full-size submarine hull section.

The SIR project represents one of two approaches being taken to the problem of driving submarines by atomic energy. The other reactor, now under test at Arco, Idaho, utilizes "slower" neutrons than the "intermediate" speed of those in the SIR reactor. It is identified as the STR, for Submarine Thermal Reactor. The Chicago Bridge and Iron Co. built the sphere.



This cross-section gives a detailed view of placing a floor, consisting of 28,000 tons of crushed limestone and a 3-ft concrete topping, inside the sphere that will house the AEC's new atomic submarine reactor. The shadowy structure in the sphere is an imaginary conception of the atomic reactor.

Huge Accelerator to Be Built at Brookhaven

An ultra-high-energy particle accelerator for nuclear research will be built at the Brookhaven National Laboratory, with approval of the U. S. Atomic Energy Commission. An alternating gradient synchrotron, the new machine will be designed to produce beams of protons of energies ranging up to 25 billion electron volts. The cost of design and construction of the new accelerator is estimated at $20,000,000. Design work will start soon, and completion of the machine in five of six years is expected. Once in operation, it will be available to scientists wishing to collaborate in Brookhaven research programs or to carry out independent programs.

The Brookhaven National Laboratory is operated for the AEC by Associated Universities, Inc., a corporation formed by nine northeastern universities. The institutions represented are Columbia, Cornell, Harvard, Johns Hopkins, Princeton, and Yale universities, and Massachusetts Institute of Technology, the University of Pennsylvania, and the University of Rochester.

AEC Approves Nuclear Power Study by TVA

Under the terms of an agreement with the Atomic Energy Commission, the Tennessee Valley Authority will make a study of various economic and technical aspects of nuclear power production, similar to the studies under way by private industrial groups. All costs of the one-year study of the immediate and long-range possibilities of commercial nuclear power will be borne by the TVA. One of the nation's largest single power producers, the TVA is currently supplying a major portion of the power for AEC facilities as Oak Ridge, Tenn., and Paducah, Ky.

U.S. Steel Ships First Ore from Venezuela

As the climax to a nine-year program of exploration for new iron-ore supplies and of construction to develop the fabulous Cerro Bolivar deposit discovered in the wilds of Venezuela in 1947, the United States Steel Corp. shipped its first load of ore from the mine on January 11. The president of Venezuela and other government officials joined with officials of the U. S. Steel Corp., and its subsidiary, the Orinoco Mining Co., in ceremonies at Puerto Ordaz on the Orinoco River, where completion of the loading of a ship with 8,000 tons of ore was celebrated. The celebration included a huge barbecue for 5,000 employees and guests of the Orinoco Mining Co.

The ore, which will go to the company's new Fairless Works at Morrisville, Pa., was brought by rail from Cerro Bolivar to Puerto Ordaz. From the river port the ore will have a 176-mile journey down a channel in the Orinoco dredged by the company to the sea. Both the port and 91-mile railroad were built by the company as part of the huge construction program entailed in developing the deposit. The engineering works required to develop the project, which represents an investment of some $170,000,000, are described in an article in the December 1953 issue (page 31).

The company expects to ship 4,000,000 tons of ore this year, gradually increasing the volume until the annual flow reaches 10,000,000 tons by 1956. Capped by a 230-ft thickness of exceptionally high-grade ore, Cerro Bolivar has a proved yield of 500,000,000 tons.

Three Contractors to Build Spanish Bases

Three joint contractors for construction of the air and naval bases the United States will build in Spain as part of its military defense program (November issue, page 82) have been announced by the Navy Bureau of Yards and Docks. They are the Raymond Concrete Pile Co., New York; the Walsh Construction Co., Davenport, Iowa; and Brown & Root, Houston, Tex. The same contractors have just completed a similar project in France, where the joint venture was known as Construction Management & Engineering Associates.

It is expected that the first airbases will be built at Zaragoza and Torrejon, northeast of Madrid; Moron, southeast of Seville; and El Copero, on the outskirts of Seville. Naval facilities will be built at Cadiz. Though the first $50,000,000 of the $150,000,000 project is available, construction will not start until May. The Bureau of Yards and Docks is administering the program for the Air Force.

Portable Army Bridge

An experimental scissors-type bridge, which is carried and launched by a turret-less tank, unfolds during recent demonstration at Fort Belvoir, Va. Made of aluminum, the bridge is designed to carry loads up to 60 tons. It is operated hydraulically and folds back over the tank for carrying. Developed by the Army Corps of Engineers at its Fort Belvoir Research Laboratories, the structure is one of three new types of military briges designed to carry the heaviest Army equipment used by field troops. Wide World photo.

Construction Activity Sets New Record in 1953

Expenditures for new construction put in place in 1953 totaled $34.8 billion, the highest amount recorded in the 39 years for which data are available, according to preliminary estimates of the Building Materials and Construction Division of the U.S. Department of Commerce and the U.S. Department of Labor's Bureau of Labor Statistics. The year was marked by a continued increase in most types of construction that had been retarded earlier because of war and defense needs.

Private construction was up 8 percent from 1952 to $23.6 billion in 1953, and public outlays rose 4 percent to $11.2 billion. New records were established for private spending on commercial, religious, educational, and public-utility construction, and for public outlays on schools, highways, and sewer and water construction.

The year 1953 was at peak also in terms of physical volume (expenditures adjusted for price changes), with an indicated gain of almost 5 percent from 1952.

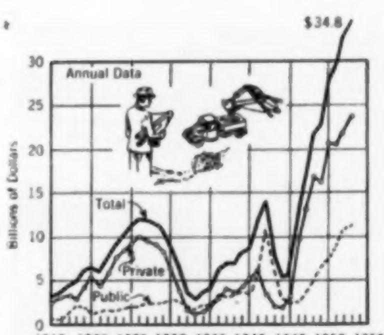
Federal funds expended for new construction during the year amounted to almost one-seventh of total outlays (private and public) for new work done—about the same proportion as in 1952.

Private spending for residential building rose 7 percent from 1952 to almost $12 billion in 1953, and for the eighth consecutive year exceeded total expenditures for all public construction activity. Commercial building, freed from the materials and credit limitations of previous years, soared to $1.8 billion in 1953—an increase of 58 percent from 1952. Religious building and private school construction, each of which had slumped to annual expenditures ranging from only $6 million to $31 million in the war years, rose about 20 percent from 1952 to peak levels of $474 million and $425 million, respectively, in 1953. Spending for social and recreational building increased 30 percent.

The only types of private work to show a decline from 1952 were industrial plant (down slightly to $2.2 billion), farm construction, and hospital building. The latter two categories have been declining from the peak levels of 1951.

The 1952–1953 rise in public construction expenditures mostly reflected gains in highways, schools, federal industrial plant, and sewer and water construction. Over one-fourth ($3.2 billion) of total public construction expenditures in 1953 went for new highways. Construction of public schools rose almost 8 percent from 1952 to $1.7 billion, compared with a wartime low of $41 million in 1944. In contrast public outlays of $1.8 billion for industrial plant (up slightly from 1952) amounted to just about half such outlays at peak expansion during World War II. Military and naval construction held at about the same level as in 1952, but public spending for housing was 15 percent lower in 1953, and for new hospitals 27 percent lower.

The usual decline in construction activity in the closing months of the year was no more than seasonal in 1953, as most types of construction remained strong. December expenditures were down 11 percent from November, but were 4 percent above the December 1952 total.



Construction expenditures for 1953 at $34.8 billion, break 39-year record. Volume of construction was also at new high. Increase over recent years is indicated here in Department of Commerce curves.

ASTM Committees Advance Work on Standards

Significant progress in recent months in the work of several committees of the American Society for Testing Materials in important fields is reported.

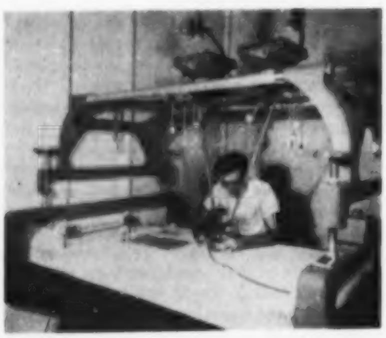
The sponsoring Committee on Blended Cement of ASTM Committee C-1 on Cement, at its fall meeting at Purdue University, accepted the report of a working group on a proposed specification for portland pozzolan cement, prepared after many months of study and review by the group. It is expected the proposed specification will be submitted for acceptance as a Tentative at the annual meeting of the ASTM in June 1954. Committee C-1 also recommended the deletion of Standard Specification for Natural Cement (C 10-37), at the same time recommending the advancement to Standard of the Tentative Specification for Natural Cement (C 10-52 T) which will replace the older Standard. These recommendations will also be considered by the society in June.

Renewed activity in the field of silicate mortars is reported by Committee C-3 on Chemical Resistant Mortars. Classification of the several types of silicate mortars will be made, with the subcommittee concentrating on the development of bond, compressive, and tensile strength methods on chemical-setting sodium silicate mortar. The present Tentative Method of Test for Chemical Resistance of Hydraulic-Cement Mortars (C 267 T) was recommended for advancement to Standard at the first opportunity. The Subcommittee on Hydraulic Mortars also will canvass the industry for information on hydraulic cement-latex combinations.

The preparation of a tentative specification for fly ash as an admixture in concrete took a major step forward at the fall meeting of Committee C-9 on Concrete and Concrete Aggregates. In view of the changes in the final draft of the specification, it will now be necessary to rewrite the Test Method for Fly Ash as an Admixture for Portland Cement Concrete (C 311-53 T). Significant developments were reported in the study of chemical reactions of aggregates and concrete, and the subcommittee dealing with this subject presented a draft of a proposed tentative method of test for potential volume change of cement-aggregate combination.

The last edition of "Significance of Tests of Concrete and Concrete Aggregates" (Special Technical Publication 22), sponsored by Committee C-9, is exhausted, and the committee has accepted a proposed outline for an entirely new edition, which will be expanded to include the significance of properties, as well as tests of concrete and concrete aggregates. It is expected the publication project will be completed early in 1955.

Photogrammetric Engineering Firm Has New Headquarters



Below is drafting room in the new headquarters for Jack Ammann Photogrammetric Engineers, of San Antonio, Tex. More than 200 are employed in the company's expanded quarters, consisting of a three-story and basement building with over 50,000 sq ft of working space. A pioneer in the aerial mapping field, the firm was the first commercial organization in the country to use the multiplex stereoscopic plotting equipment. Small photo shows a Kelsh Plotter, latest American development in the field and one of three types of stereoscopic plotting instruments used by the firm.

Film on Hydraulics Research Available

A 16-mm sound and color film, made by the National Bureau of Standards and describing the general features of four separate hydraulics investigations, is available on loan to groups having a specific interest in hydraulics research. The experiments deal with the damping of standing waves, dam-break waves, diffusion of jets, and density currents. Running time is about 17 minutes.

Information on the availability of the film may be obtained from the Office of Scientific Publications, National Bureau of Standards, Washington 25, D.C.

1953 a Year of Records For Aluminum Industry

A number of new records were set in the aluminum industry in 1953. On the basis of statistics for the first ten months, primary aluminum production for the year is estimated at 2,500,000,000 lb, an increase of about 33 percent over the 1952 production of 1,872,664,367 lb. Production in 1953 would have been still higher, had it not been for a power shortage in the South which resulted in some loss of production in that area during the last quarter.

The industry's expansion program moved ahead on schedule during the year so that by the end of the year its annual primary capacity stood at approximately 2,840,000,000 lb, including about 158,000,000 lb of stand-by capacity using high-cost power. New fabricating plant construction was also on schedule during the year, though the third round of primary capacity expansion, which was announced late in 1952 and which would have brought three new producers into the industry, has not materialized. This additional capacity is still under consideration by the government and may be carried forward during the coming year.

The industry's increasing production eased the aluminum supply situation considerably during the year, with the result that more metal is available for civilian use than at any time since the outbreak of the Korean war. Aluminum users may expect to find more metal available in 1954 over and above the additional metal to be taken for the national stockpile. Shipments of aluminum products also showed large increases during 1953.

Several new alloys were introduced by the industry during the year. These included an aluminum-magnesium sheet alloy for general metal-working requirements, with a nominal magnesium content of 0.9 percent and a new high-strength extrusion alloy developed primarily for aircraft applications and having an ultimate tensile strength of about 100,000 psi.

Wharf and Bulkhead Shed To Replace New York Piers

The Port of New York Authority has been authorized by the city to build a $1,300,000 marginal wharf and bulkhead shed to replace Piers 78 and 79 on the North River between 38 and 40th Streets. Pier 78 lies in the path of the Third Tube of the Lincoln Tunnel, now under construction. Pier 79 was removed when the first two tubes of the tunnel were built several years ago.

The new marginal wharf will be 450 ft long and 110 ft wide, with a pile-supported concrete deck. It will include a one-story, steel-frame shed, with protective metal siding and cargo doors on the river and shore sides. Designed as a replacement for the existing Pier 78, which now handles all types of freight by carfloat and lighter, the wharf may also be of future use as a headhouse or bulkhead shed for possible finger-pier construction by the city.

Chamber of Commerce Urges More Toll Roads

Construction of more toll roads was called a practical answer to the problem of "taking the bumps out of America's highways without flattening the taxpayers" at the recent National Conference on Highway Financing in Washington, D.C., sponsored by the Chamber of Commerce of the United States.

Charles L. Dearing, Deputy Undersecretary of Commerce for Transportation, forecast that within ten years approximately one-third of the total rural area of the 38,000-mile interstate highway system can be brought up to par by means of wholly self-liquidating toll projects. He estimated that such projects could accommodate about half the rural traffic using the interstate system. Further in the event of recession, these same toll projects would create many thousands of new jobs, he said. "Toll roads have been far more successful than the experts forecast," the Chamber points out. "Motorists have shown they are willing to pay premium prices to drive on premium roads."

While the conference was called to discuss the broad subject of highway financing, much of the discussion centered about the subject of federal aid, especially the income from the two-cent federal gas tax. Walter J. Kohler, governor of Wisconsin, opened the debate with a proposal of the recent Conference of Governors that the tax be turned over to the states. In the panel discussion that followed Rep. J. Harry McGregor, chairman of the House Subcommittee on Roads, was one of several speakers opposing this stand. He strongly advocated retention of the federal gas tax. Getting rid of the tax, he said, "would automatically do away with the Bureau of Public Roads with all its coordinating activities."

The attendance of more than 400 included state and federal officials, representatives of the transport and highway construction industries, and members of Congress.

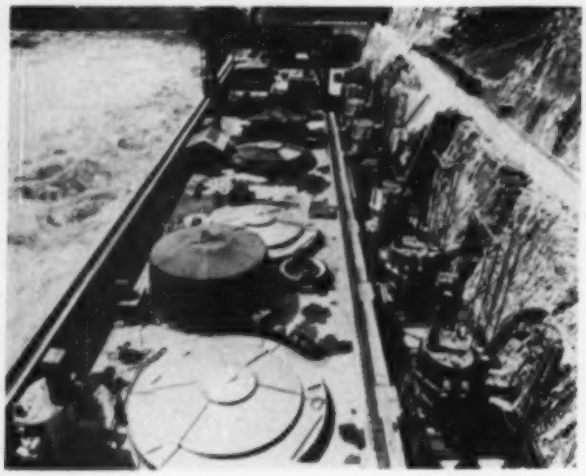
Turnpike Officials Plan for the Future

As a first step toward establishing standards of uniformity that will assure maximum safety on the toll roads now in use and those being planned, officials of three turnpikes—Pennsylvania, New Jersey, and Ohio—met recently at Harrisburg, Pa., to discuss subjects relating to the safe operation of motor cargo vehicles on their superhighways. T. J. Evans, chairman of the Pennsylvania Turnpike Commission, welcomed the officials—among them Charles M. Noble, M. ASCE, chief engineer for the New Jersey Turnpike, and J. Gordon McKay, and T. J. Kauer, M. ASCE, member and chief engineer of the Ohio Turnpike Commission.

David E. Watson, member of the Pennsylvania Turnpike Commission and presiding officer, deplored the "complete lack of uniform codes, rules, and regulations with respect to what are considered highly desirable and necessary uniform standards." During the past few years, he said, "the Commission has conducted surveys and studies in the hope that it will be able to arrive at conformity with the Pennsylvania Motor Vehicles Code, the rules and regulations of the Pennsylvania Public Utility Commission, and the rules and regulations of the Interstate Commerce Commission." However, he said, the Turnpike did not see fit to enact or promulgate such a code until the other two commissions were advised of its intention and given an opportunity to discuss it.

Japanese Dike Destroyed by Typhoon

Breaks in the sea wall near Matsusaka, Japan, caused by waves and high tide during last summer's severe typhoon, are shown in the large photo taken by John C. King, A.M. ASCE, chief engineer for the Prepakt Concrete Co., on a recent visit to Japan. These dikes are sand and dirt-filled ridges protected on the seaward side by a concrete and concrete-filled masonry blanket, and covered on the top and rear only by grass, weeds, and a few trees, which offered little resistance to washing. The vertical view shows workmen making temporary repairs with sand-filled bags stacked and wired together. The bags are made of rice-straw matting. Such a wall, though not watertight, will keep the high tides out. Permanent repairs will soon be made in the form of a well-founded, sloping concrete seaward wall with wave deflector at the top plus concrete or masonry paving over the top and rear.



Cabinet Gorge Plant Has Highest Head Propeller Turbines

The Washington Water Power Company's Cabinet Gorge hydroelectric plant on the Clark River in northern Idaho has two firsts to its credit—it is the highest head installation of propeller-type turbines in the United States, and has the longest penstocks ever used with this type of turbine. The installation consists of four Baldwin-Lima-Hamilton Corp. propeller turbines rated at 70,500 hp, 120 rpm under 90-ft effective head. Maximum head will be 105 ft, at which the turbines will develop 85,000 hp. Three of the turbines are of the fixed-blade propeller type, and the fourth has an adjustable blade runner. The latter type will handle the system load swings, while the fixed-blade turbines operate on base load at maximum efficiency. The first unit went into commercial operation in September 1952, and the last in August 1953.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"Thanks, Professor Neare, for the vacation," beamed Joe Kerr.

"What vacation?"

"Xmas vacation without a problem" You thot you gave us one on the hydromagnetic spherometer at the December meeting, but here's my tabulation of the data showing that you forgot to give either the magnetic or suspender tension for the third position:

No.	*H*	*N*	*M*	*S*
1	12	12	0	*W*
2	14.5	8.5	0	0
3	28	3	?	?

Not having data to compute the effective specific gravity of the sphere, I answered the other question which you said you might have asked: when the magnet is switched off, the sphere pops out like a slung shot."

"Oh it does, does it!" jeered Cal Klater. "I'll spike that after I tell Noah the answer and how I got it. Since the volume of a spherical segment is $\frac{\pi}{3}h^2(3r-h)$, the 6-in. immersion of the sphere as the stage rose 2.5 in. in the cylinder reduces to:

$$2.5\pi R^2 = \frac{\pi}{3}6^2(3r-6) \quad . \; . \; . \; . \; (1)$$

$$72r = 5R^2 + 144 \quad . \; . \; . \; . \; . \; (2)$$

$$72(R-r) = 5(R-2.4)(12-R) \quad . \; (3)$$

So, unless R is in the range 2.4 to 12, Eq. (3) will be negative, $r>R$, and the sphere won't fit inside the cylinder. That defines the third position; $H - N = 25$, the sphere must be entirely submerged. Specific gravity can be computed from the ratio of buoyant to full displacement,

$$\text{s.g.} = (14.5-12)/(28-12) = 5/32 \quad . \; (4)$$

which is my answer."

"Exactly!" ejaculated the Professor, "and . . ."

"Just a moment," begged Cal, "while I unpop Joe's popgun. The final volume relation is

$$16\pi R^2 = \frac{\pi}{3}4r^2(3r-2r) \quad . \; . \; . \; (5)$$

$$12R^2 = r^3 \quad . \; . \; . \; . \; . \; . \; (6)$$

which combines with (2) to give

$$5r^3 - 864r + 1728 = 0 \quad . \; . \; . \; . \; (7)$$

$$r = 12,\ 2.05 \text{ or } -14.05 \quad . \; . \; . \; (8)$$

The last two roots are spurious, so $r = 12$. From (6), $R = 12$ as well, so the bullet in Joe's popgun is a friction-bound vapor-locked dud."

"Practically," agreed Professor Neare, "tho elasticity of sphere and cylinder will allow a slow rebalancing. Things will happen faster in our next, which involves triple pursuit.

"In Yawaraf, the yawar preys on the awara, the awara on the waraf, and the waraf on the yawar. The biological balance is close, since each species can run a mile a minute and find its prey two miles away. One morning when a yawar, an awara and a waraf out hunting each smelled breakfast at 6:00, each rushed his prey at top speed, and, the race ending in a triple tie, each swallowed as he was swallowed, and all disappeared. What time was breakfast?"

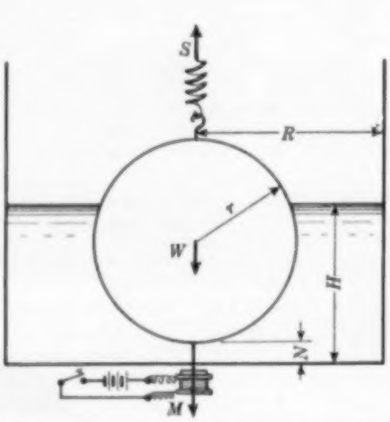


FIG. 1. The hydromagnetic spherometer was a tighter fit than this.

[*Cal Klaters by the dozen: Stoop (John L.) Nagle, Richard Jenney, Flo Ridan (Charles G. Edson), Ignor Antenuff (Paul Hartman), Don'T (Don Thayer), Old Cut'n'try (Warner Harwood), O'Kay (Otto Koch), Jerald N. Christiansen, GI (Morton) Raff, Del Awarian (G. N. Hyland), Homer W. Woodbury, Sauer Doe (Marvin Larson), and Gor Blimey (Gordon V. Kibblewhite). The Yawaraf breakfast sprang from a suggestion by Joseph M. Brandstetter. Also acknowledged are Rudolph Meyer's and Julian Hinds' solution of November's cockeyed cube.*]

DECEASED

James Wendell Adams (A.M. '30), age 57, consulting civil engineer of New York City and Mineola, L.I., who worked on the design and construction of many large airports, died at his home at Hempstead, L.I., on December 15. Following graduation from Rensselaer Polytechnic Institute in 1925, Mr. Adams was connected with the Foundation Co., of New York, and the Borough of Mountain Lakes, N.J. From 1929 to 1945 he was chief engineer of the airport division of Curtiss-Wright Air Terminals, Inc., and from 1945 to 1947 chief engineer and consultant on airports to McLaughlin-Carr Associates, both of New York. His assignments included the design and construction of airports at Presque Isle, Me., Nashville, Tenn., Tripoli, North Africa, and for Suffolk County, Long Island.

Curtis Gordon Bradfield (M. '45), age 49, since 1943 public works officer for the U.S. Coast Guard at Baltimore, Md., died at his home in that city on November 30. Mr. Bradfield joined the Coast Guard in 1938 as senior civil engineer. Earlier he had been with the Baltimore & Ohio Railroad Co., the H. K. Ferguson Co., and the Western Electric Co., and was in private practice for five years. He attended the Baltimore Polytechnic Institute.

Duncan McEvoy Campbell (M. '46), age 59, since 1939 chief engineer of the Cook County (Ill.) Highway Department, died in Chicago on November 24. Mr. Campbell had been with the department since 1917 except for a year in the Army during World War I. He was a graduate of the University of Illinois.

Fredrick Julius Cellarius (M. '12), age 87, president of the F. J. Cellarius Engineering Co., of Dayton, Ohio, and alumnus of Ohio State University, died on March 28. Engaged in private practice since 1912, Mr. Cellarius had devoted most of his time to municipal engineering. His early positions included those of assistant city engineer of Dayton (1894–1908); city engineer (1908–1912); member of the Board of Park Commissioners (1912–1914); and a member and president of the City Plan Board of Dayton (1936–1948). Active in professional affairs, he was president of ASCE's Dayton Section and was the Section's first life member.

Dean John Converse (J.M. '47), age 32, lieutenant, U.S.N.R., died in an accident while flying aboard the U.S.S. Rendova on December 3. A resident of St. Paul, Minn., Mr. Converse worked for a local firm, the Banister Engineering Co., before he was called to duty. He received the bachelor of civil engineering degree from the University of Minnesota in 1947.

Harry Westbrook DeGraff (M. '15), age 76, since 1945 retired engineer of Amsterdam, N.Y., died in that city on September 28. A graduate of Union College, Mr. DeGraff entered the Department of the State Engineer at Albany, N.Y., in 1896 and served as deputy state engineer in 1909 and 1910. He then began his long association (1911–1945) with the American Pipe & Construction Co., Philadelphia, Pa., holding at various times the positions of engineer, field manager, superintendent and general manager.

John Frank Fucik (M. '37), age 68, assistant engineer with the city of Chicago, Ill., died there in December 1953. Mr. Fucik had served the city without interruption for 46 years. He was a civil engineering graduate of the University of Illinois, class of 1906.

Elwood Campbell Kent (J.M. '49), age 28, first lieutenant in the Air National Guard and a veteran of World War II, was killed in a jet plane crash near Atlanta, Ga., on December 6. Since graduating from the Georgia Institute of Technology in 1949, Lieutenant Kent had been employed by the Virginia Department of Highways, the South Atlantic Division of the Corps of Engineers at Atlanta, and Robert and Co., Associates, Architects and Engineers. He was a licensed professional engineer in the states of Georgia and Virginia.


Elwood C. Kent

Everett Hamilton Hatch (A.M. '11), age 73, connected with the Walsh Construction Co., on projects throughout the United States, for 20-year period, died in Oakland, Calif., on December 14. Projects with which he had been connected include the Queens-Midtown Tunnel, the Delaware Aqueduct, Fort Peck Dam diversion tunnels, and several tunnels for the Pacific Gas & Electric Co., in California. Before joining the Walsh firm, he worked for P G & E, the British Columbia Electric Co., and the city of San Francisco. Mr. Hatch was an alumnus of Stanford University, class of 1908.

Judson Clifford Heindel (A.M. '41), age 58, structural engineer in the Power Engineering and Construction Division of the Tennessee Valley Authority, at Chattanooga, Tenn., died on November 27. Connected with the TVA since 1937, Mr. Heindel was formerly employed by the New York Power & Light Corp., Albany; the General Electric Co., Schenectady; the Southern Engineering Co., Charlotte, N.C.; the Koppers Co., Pittsburgh; and the city of Birmingham, Ala. Mr. Heindel was an alumnus of Union College.

Henry Atkinson Holdrege (A.M. '04), age 79, retired engineer of Omaha, Nebr., died on July 17. Prior to his retirement in 1938, Mr. Holdrege was associated with the Chicago Telephone Co., the Omaha Electric Light & Power Co., and the Nebraska Power Co. He was an alumnus of the Massachusetts Institute of Technology, class of 1895.

Clifton Stewart Humphreys (M. '10), age 85, since 1911 hydraulic and civil engineering consultant of Madison, Me., died in that city on December 23. From 1899 to 1910 Mr. Humphreys was a member of the firm, Snow and Humphreys, Engineers, of Boston and Madison. He was an alumnus of Dartmouth College.

Stuart Wilson Jackson (M. '17), age 72, who retired in 1950 as district engineer for the Pennsylvania State Department of Highways after 45 years of continuous service, died recently. His home was at Franklin, Pa. In his capacity as district engineer at Franklin—a post which he held from 1939 until his retirement—Mr. Jackson was in charge of highway work in six counties. He was a graduate of Allegheny College.

Joseph Alexander Jordan (M. '47), age 57, who was last engaged as a civil engineer with Knappen, Tippetts, Abbett, McCarthy, in Rangoon, Burma, died on November 30. Mr. Jordan had been with the Kuljian Corp., and Alvin Albinoe, Inc., of Washington, D.C.; and the Candeloro Construction Corp., Healy-Giardino, Inc., and the Fisher-Blake Co., all of New York, on projects throughout the world. He had also been associated with Hugh Lee Kirby as consultant on railroad construction in Wyoming and Montana.

John Stephen Macdonald (M. '27), age 60, vice-president of the Walsh Construction Co., of Davenport, Iowa, and New York, died in Bronxville, N.Y., on January 1. A graduate of Dartmouth College and the Thayer School of Engineering there, Mr. Macdonald joined the construction firm of Patrick McGovern, Inc., Boston, in 1914, advancing to chief engineer and vice-president by 1928. In 1936 he became chief engineer of the Walsh Construction Co. Mr. Macdonald was in charge of construction of the Queens Midtown Tunnel, the subway tunnels under the East River at 53rd and 60th streets, and several jobs connected with the New York-Delaware water-supply system, near Catskill, N.Y.

Elmer Andrew Nelson (A.M. '29), age 52, civil engineer with the U.S. Air Force, Washington, D.C., died at Takoma Park, Md., on November 25. In government service since 1934, Mr. Nelson had been a structural engineer and consultant for the Treasury Department and coordinator and chief of estimates and specifications for the Construction Division, at the Army Air Force's Pentagon headquarters. Previously he worked for the National Fireproofing Corp., in Pittsburgh, and Chicago. He was a 1923 graduate of the University of Minnesota.

Tom William Osgood (A.M. '12), age 72, retired engineer of Los Angeles, Calif., died on February 20, 1953. Early in his career, Mr. Osgood was city engineer of Medford, Oreg., and then maintained a private practice there for eight years. Engaged in the California state service for 20 years, he was construction engineer and assistant superintendent in the Department of Safety of the Industrial Accident Commission (1917–1933) and chief safety en-

gineer for the Metropolitan Water District of Southern California (1933–1938). Before retiring in 1943 he had also worked for the Bates & Rogers Construction Corp., Chicago, and the Pennsylvania Turnpike Commission. Mr. Osgood studied at the North Dakota State Agricultural College and the Massachusetts Institute of Technology.

George Edmond Russell (M. '25), age 75, professor emeritus of hydraulics at the Massachusetts Institute of Technology, died at Lexington, Mass., on December 11. Dr. Russell retired in 1943, but continued to teach during the war years. He had been a member of the M.I.T. faculty since 1905, attaining the rank of professor in 1921. The author of a textbook on hydraulics, Dr. Russell served as water supply consultant for several communities and state commissions. He held the bachelor of science degree from M.I.T.

Lloyd Winfield Strayer (M. '51), age 67, consulting engineer of New Castle, Pa., since his retirement in December 1950 as chief civil engineer of the Pittsburgh Limestone Corp., following 30 years of service, died on September 23. At the time of his death he was consultant for the Michigan Limestone & Chemical Co. For ten years prior to his association with the Pittsburgh Limestone Corp., Mr. Strayer was in the maintenance-of-way department of the Baltimore & Ohio Railroad at New Castle. He was an alumnus of Purdue University.

Marney Ben Willey (M. '48), age 58, for the past nine years chief engineer of J. Ray McDermott and Co., Inc., Harvey, La., died in New Orleans on November 28. Mr. Willey was employed by the Shell Oil Co., from 1932 to 1943, and for a brief period had a consulting practice at Lake Charles. Mr. Willey was one of the pioneer designers of a platform for holding off-shore oil-drilling rigs. He was a graduate of the State University of Iowa.

Frank Arner Windes (M. '26), retired engineer of Winnetka, Ill., died on June 7. He was a graduate of the University of Michigan, class of 1893. Mr. Windes was president of Windes & Marsh from 1909 to 1943. From 1899 to 1926 he also served as city engineer of Winnetka.

Pope Yeatman (M. '93), age 92, retired mining engineering consultant of Philadelphia, Pa., and one of the Society's oldest members in point of affiliation, died on December 4. A principal of the New York firm, Yeatman & Berry, from 1916 to 1941, he maintained an independent consulting practice in New York from 1941 until his retirement in 1948. Mr. Yeatman acted as consultant and manager for several gold and copper mining enterprises in South Africa, Nevada, and Chile. For his work as director of the Non-Ferrous Metals Division of the War Industries Board (1918–1919) he was awarded the Distinguished Service Medal in 1923. He was an alumnus of Washington University.

NEWS OF ENGINEERS

John Bliss, New Mexico State Engineer at Sante Fe, retired on November 1 to enter private practice.

Horace B. Compton, principal engineering personnel technician in the New York State Civil Service Department at Albany, N.Y., has been appointed director of personnel in the Department of Public Works. Mr. Compton is a graduate of Rensselaer Polytechnic Institute and taught engineering there from 1921 to 1941.

Calvin V. Davis, associate in the Harza Engineering Co., Chicago, Ill., was elected president of the firm on December 31 succeeding the late **Leroy F. Harza. E. Montford Fucik,** vice-president, was appointed executive vice-president, and **Richard D. Harza** vice-president.

James Girand has been appointed chief operations executive of the Elizabethtown Water Company, Consolidated, Elizabeth, N.J. For the past four years Mr. Girand has been vice-president in charge of operations for the New York Water Service Corp.,

(*Continued on page 84*)

News of Engineers

(*Continued from page 83*)

in New York, N.Y. Earlier he was city engineer of Phoenix, Ariz., and superintendent of the water department there.

Joseph F. Golden, formerly member of the El Centro, Calif., consulting firm, Golden and Bryant, has established a new organization at Yuma, Ariz., with **Frederick L. Clock,** local architect, to be known as Clock and Golden, Associated Architects and Engineers

John L. Gressitt, chief engineer of the Pennsylvania Railroad for the past eleven years, retired in January after 45 years of railroad service. Beginning as a chairman in 1908, he was at various times, division engineer superintendent at Sunbury, St. Louis, Indianapolis and Chicago, and assistant chief engineer of maintenance for the system.

Guy E. Griffin, water supply engineer with the American Cyanamid Co., New York, N.Y., has been appointed deputy commissioner in charge of the sewer division of the Westchester County Department of Public Works, White Plains, N.Y. His experience includes positions with Metcalf & Eddy, Boston, Mass., and the city of Greenwich, Conn.

William F. Heavey, brigadier general, U.S. Army, retired, has been appointed general manager for the four architect-engineer firms holding the contract for work on the United States bases to be built in Spain. For the past four years General Heavey has been with Frederic R. Harris, Inc., one of the four participating architect-engineer firms. **Charles Hitchcock,** associated with Metcalf & Eddy-Alfred Hopkins construction work on the Thule air base in Greenland, has been appointed assistant general manager on the project.

C. D. Riddle, chief engineer with the Walsh Construction Co., in New York, N.Y., has been elected vice-president in charge of engineering.

I. R. Wanke, lieutenant colonel, and executive officer of the Norfolk (Va.) District of the Corps of Engineers, has been reassigned to duty with the Armed Forces in the Far East.

Roger H. Gilman has been promoted from deputy director to director of port development of the Port of New York Authority. Mr. Gilman joined the Port Authority staff as a statistician in 1937. During World War II he served in the U.S. Navy for three years, with the rank of lieutenant. He is currently a director of the Metropolitan Section of the Society.

Roger H. Gilman

Louis J. Rumaggi (right), colonel, Corps of Engineers, U.S. Army, and assistant chief of staff in the Eighth Army Engineer Section in Korea, receives the Oak Leaf Cluster to the Legion of Merit from Gen. Maxwell D. Taylor, Eighth Army Commander, during ceremonies near Youngsan. Colonel Rumaggi is a veteran of three major campaigns in the Pacific theater during World War II and holder of the Commendation Ribbon.

Sidney L. McFarland has resigned as head of the Coordination of Plans Section, Project Planning Division of the Bureau of Reclamation in Washington, D.C., to accept the position of irrigation and reclamation consultant with the Interior and Insular Affairs Committee of the House of Representatives.

Milo S. Ketchum has entered into a partnership with **E. Vernon Konkel** for the practice of structural engineering under the firm name of Ketchum and Konkel, Consulting Engineers. Their offices are at 1090 Fox Street, Denver, Colo. Mr. Ketchum was previously engaged in his own consulting practice in that city.

James Kip Finch, dean emeritus of the faculty of engineering and Renwick professor emeritus of civil engineering in the Columbia University School of Engineering, New York, N.Y., was one of 44 recipients of honorary degrees granted by the university on January 11 at the first of three academic convocations marking its bi-centennial year. The honorary degree of doctor of science was awarded to Dean Finch.

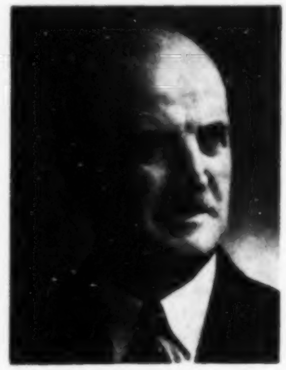
Donald D. King, editor of "Construction Equipment," and former editor of Civil Engineering, was recently initiated an honor member of the Cooper Union Chapter of Chi Epsilon, civil engineering fraternity. Mr. King was in charge of production on Civil Engineering from its inception in 1930 until 1943, when he resigned to serve as information officer in the Pentagon headquarters of the U.S. Air Force. As editor of Civil Engineering from 1946 to 1949, he was responsible for improving the format and typography.

(*Continued on page 86*)

News of Engineers

(*Continued from page 85*)

Chalmers J. Mackenzie, who has been serving as consultant to Atomic Energy of Canada, Ltd., since his retirement as president of the organization on October 31, was recently awarded the Kelvin Medal "for outstanding service in the field of engineering." The medal is given once every three years on joint recommendation of the presidents of eight leading British institutions. Dr. Mackenzie, who was made Honorary Member in ASCE at the Centennial Convocation in 1952, is also chairman of the Atomic Energy Control Board of Canada.



Chalmers J. Mackenzie

L. M. Klauber, for the past five years chairman of the board and chief executive officer of the San Diego Gas & Electric Co., has retired from that position after 43 years of service with the company. He will continue as a member of the Board of Directors, and of the executive and finance committees of the company.

W. E. Robinson, president of the Robinson Clay Products Co., Akron, Ohio, was honored for long and continuous service with the firm, with the presentation of a 35-year pin award.

Putnam R. Warwick, for the past 18 months engineer with the San Diego Harbor Department has been appointed city engineer and city planning engineer of National City, Calif. In the past he has been with the Palo Verde Irrigation District at Blythe, and the Long Beach School Department.

Mark K. Wilson, Jr., member of the Chattanooga (Tenn.) firm, Mark K. Wilson Co., has been elected president of the Chattanooga Chamber of Commerce for 1954.

William T. Wright, chief engineer and partner in the architectural engineering firm of Kistner, Curtis & Wright, Los Angeles, Calif., has been appointed to fill a vacancy on the California Board of Registration for Professional Engineers caused by the death of **Paul Jeffers.**

N. V. Back has been promoted from maintenance-of-way engineer to chief engineer of the Toronto, Hamilton & Buffalo Railway Co., at Hamilton, Ontario.

Heathcote W. Lawson, of Englewood, N.J., was recently named assistant chief engineer of Schacht Steel Construction Inc., of Hillside, N.J., and New York, N.Y. At one time he was with the Bethlehem Steel Co., and he is a former president of the Lehigh Valley Section.

Earle V. Miller, state highway engineer with the Idaho State Highway Department at Boise, has been elected president of the Western Association of State Highway Officials. Other new officers include **C. O. Erwin,** district highway engineer, New Mexico State Highway Department, Roswell, vice-president; and **W. E. Willey,** engineer, Division of Economic and Statistics, Arizona State Highway Department, Phoenix, secretary. Named to the executive committee are **D. C. Greer,** highway engineer, Texas State Highway Department, Austin; **W. A. Bugge,** director of highways for the State of Washington, Olympia; and **W. C. Williams,** first assistant highway engineer, Oregon State Highway Commission, Salem.

Paul J. Raver recently resigned as head of the Bonneville Power administration after 14 years of service with the agency, to take the post of superintendent of the Seattle, Wash., City Light Department. **Dr. William A. Pearl,** director of the Institute of Technology at Washington State College and director of industrial research for the Bonneville Power Administration, has been named to succeed Mr. Raver.

Fred S. Poorman, former deputy chief of engineering for military construction in the Office of the Chief of Engineers, Washington, D.C., has been assigned a new post in the Department of Defense. He will be head of the technical division and senior assistant to **Rear Admiral Joseph F. Jelley,** director of construction.

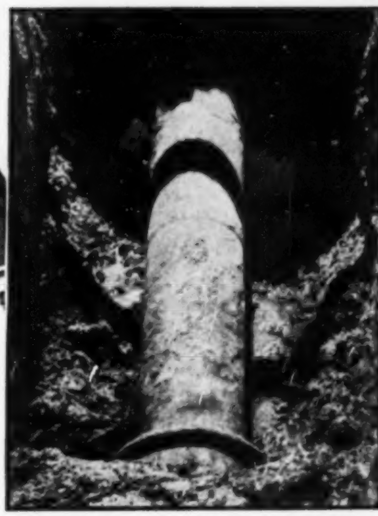
Franklyn C. Rogers, formerly on the staff of Rutgers University, was recently appointed India representative of the Harza Engineering Co., of Chicago. Associated with the Harza Co. for several years, Mr. Rogers has served as resident engineer on the Maithon hydroelectric project in India for the past two years.

D. B. Steinman received the recently established \$1,000 William Procter Prize for Scientific Achievement, awarded by the Board of Governors of the Scientific Research Society of America, at the Hotel Statler in New York City on December 28. He was cited as "a civil engineer who has added to his distinguished career in bridge design and construction a brilliant record of basic research in the aerodynamics of bridge structures and in the application of new metallurgical products in bridge construction."

P. S. Wilson, manufacturers' representative of Glen Ridge, N.J., will now represent the Welsbach Corp., of Philadelphia, Pa., in the eastern part of New York State, northern New Jersey, and part of Connecticut.

John G. Hotchkiss, of Mount Kisco, N.Y., was recently made a fellow in the New

(Continued on page 90)



This cast iron water main, uncovered for inspection, is in good condition after 100 years of service in Alexandria, Va.—one of more than 50 cities with century-old water or gas mains in service.

pipe
for Modern Waterworks Operation

News of Engineers

(Continued from page 87)

York Academy of Sciences in recognition of outstanding work toward the advancement of science. Mr. Hotchkiss is a district engineer with the American Institute of Steel Construction in New York City.

William A. Carver, currently serving with the Division of Architecture, Department of Public Works, State of California, at Sacramento, has passed the state bar examination and was sworn in as an attorney on January 19. He has accepted the appointment of acting legal counsel for the Pacific Coast Chapter of the Construction Specifications Institute, Inc.

Harry L. Kinsel, for a number of years a member of the staff of Metcalf & Eddy, Boston, Mass., was admitted to the firm as a partner on December 7.

Frank Klein and **M. C. Magnuson** announce the formation of a partnership effective January 1, to be known as Klein & Magnuson, consulting architectural and structural engineers, with offices at 82 West Washington, Chicago 45, Ill. Mr. Klein was formerly employed by Shaw, Metz & Dolio and Mr. Magnuson by the Leonard Construction Co., and Sargent & Lundy. Veterans of World War II, both men worked for the American Bridge Co., before going into service.

Walter A. Heimbuecher, city engineer of University City, Mo., has been honored at a party given by city employees to celebrate his 40 years of service in the post. The occasion was also marked by publication of a number of appreciative biographical sketches in the local press. When Mr. Heimbuecher began his job in 1913, the population of University City was 2,500, while today it is 39,892—fifth largest in the state. Since 1947 he has also been director of public works.

W. A. Heimbuecher

L. N. McClellan has been promoted from chief engineer of the U.S. Bureau of Reclamation, at Denver, to Assistant Commissioner of Reclamation. He will remain in Denver, which will be headquarters for all the Bureau's technical work under its recent reorganization plan. Mr. McClellan has spent most of his career in the Bureau—as chief electrical engineer from 1925 to 1950, and chief engineer since the latter date. He is the inventor of numerous electrical devices in the hydro-electric power field.

New Publications

Structural Design. To familiarize students and young engineers with the members of various structures, their methods of framing, and their proper names, John B. Gribbin, A. M. ASCE, consulting engineer and assistant professor of civil engineering at Manhattan College, has made available a 160-page, lithoprinted publication entitled *Structures, Their Elements and Details*. The profusely illustrated, paper-bound volume includes chapters on welded construction and on bridges, with emphasis on steel girder and truss types. Copies may be obtained from the Manhattan College Bookstore, Manhattan College, Spuyten Duyvil Parkway and West 242nd Street, New York, N.Y. The price is $3.25.

Rock Blasting. Of interest to construction and mining engineers will be a complete manual on the scientific, technical, and practical aspects of rock blasting in mining, tunneling, and excavation, compiled by Atlas Diesel, of Stockholm, Sweden. Published in four languages (Swedish, English, French, and German) in parallel texts, the manual constitutes an international forum for exchange of information and experience. A loose-leaf format will facilitate revision. Inquiries concerning the manual, which sells for $15, should be sent to Copco Pacific Ltd., 930 Brittan Avenue, San Carlos, Calif.

Ohio Geological Survey. Issuance of a new report in two parts—"Publication List" and "The Story of Ohio's Mineral Resources"—is announced by the Division of Geological Survey of the Ohio Department of Natural Resources. Identified as the Survey's Information Circular No. 9, the 47-page publication lists all reports and maps ever published by the Ohio Geological Survey and outlines the development of the various mineral resources of the state. Free copies are available from the Ohio

Department of Natural Resources, Orton Hall, Ohio State University, Columbus 10, Ohio.

Waste Water Reclamation. A recent investigation conducted in California has obtained detailed data on one method of reclaiming waste water—that of underground recharge by spreading. The investigation was conducted for the State Water Pollution Control Board by the University of California Sanitary Engineering Laboratories, using federal funds. Work was under the direction of Prof. Harold B. Gotaas, M. ASCE, and A.E. Greenberg. Issued as SWPCB Publication No. 6, the report is available in limited supply from the State Water Pollution Control Board, Room 610, 721 Capitol Avenue, Sacramento 14, Calif.

Logarithms. To meet a continuing demand for sixteen place tables of logarithms of numbers from .0001 to 5 at intervals of .0001, the National Bureau of Standards has reissued Vol. III of a four-volume table of logarithms published in 1941. Issued as Applied Mathematics Series 31, the 501 page volume is entitled *Table of Natural Logarithms for Arguments Between Zero and Five to Sixteen Decimal Places*. It may be ordered from the Government Printing Office, Washington 25, D.C., at $3.25 a copy.

Water and Politics. Vincent Ostrom has gathered together in a well-documented 300-page book, entitled *Water and Politics*, the record of the water policies in the development of the city of Los Angeles (largest U. S. city in an arid region) and the administration of these policies. It is a story of engineering dreams made real by political action. The reality consists of two great aqueducts—one from Owens Valley, the other from the Colorado River—which supply enough water for 5,000,000 people. Copies are available from the Haynes Foundation, 607 S. Hill Street, Los Angeles 14, Calif., at $4 in cloth and $3.50 in paper binding.

Explosives. Specific aid in the selection of industrial explosives for underground and strip mining, quarrying and construction, seismic prospecting, pipeline laying, and similar work is given in a new 48-page book and catalog entitled *Atlas Explosives Products*. Free copies may be obtained from the Explosives Department, Atlas Powder Co., Wilmington 99, Del.

Hydrologic Frequency Analysis. The principle and theory of frequency analysis of hydrologic data with the practical procedure of application to a specific problem is comprehensively presented in a treatise by V. T. Chow, A.M. ASCE, of the department of civil engineering, University of Illinois. Orders for the 80-page pamphlet will be filled by the Director of Engineering Information and Publications, Engineering Experiment Station, University of Illinois, Urbana, Ill. The price is 80 cents.

Urban Development. As part of its continuing program of research in urban development, the Urban Land Institute has issued its fourth bulletin on shopping centers. Identified as Technical Bulletin No. 20 in the organization's research series, the present publication illustrates adaptations of shopping center planning and management principles currently being put into practice. It sells for $6, with a discount available for quantity orders, and may be obtained from the Urban Land Institute, 1737 K Street, N.W., Washington 6, D.C.

Soil Mechanics. Issuance of two volumes of papers on soil mechanics, which have appeared in Journals of the Boston Society of Civil Engineers and of the New England Water Works Association during the past 27 years, is announced by the BSCE. Entitled *Contribution to Soil Mechanics*, the volumes may be obtained from the Boston Society of Civil Engineers, 88 Tremont Street, Boston 8, Mass., for $2.50 a volume, plus 25 cents postage (foreign $3). Volume I (a reissue) covers the years, 1925–1940, and Volume II the period, 1941–1953.

Heat Transfer. A compilation consisting of sixteen discussions of the latest scientific contributions of research and development centers throughout the United States to the field of heat transfer and fluid mechanics—presented at the 1953 Heat Transfer and Fluid Mechanics Institute—has been made available in paper-bound format by the five California colleges sponsoring the Institute. The 240-page volume sells for $5.50 (Californians add 3 percent sales tax), upon application to the Stanford University Press, Stanford, Calif.

Hydraulics Conference. Proceedings of the Fifth Hydraulics Conference—held at the Iowa Institute of Hydraulic Research at the State University of Iowa in June 1952 and edited by John S. McNown, A.M. ASCE, and M. C. Boyer—is obtainable from the Department of Publications, University of Iowa, Iowa City, Iowa. Identified as Bulletin 34, the publication (302 pages, 129 figures) sells for $3.50.

Urban Transportation. Urban problems are stressed in the *Proceedings* of the Fifth California Street and Highway Conference, held at the University of California in February 1953. Other sections of the 115-page illustrated publication deal with planning and administration, construction and maintenance, traffic, and education and research. Published by the Institute of Transportation and Traffic Engineering at the University of California, the lithoprinted volume is for sale by the University Press, Berkeley 4, Calif. The price is $2.

Surveying Equipment. The 1954 pocket-size edition of the *Gurley Ephemeris*, including a new chart of Polaris, which makes possible an observation of the star within a minute, and with minimum computation, is now available from W. & L. E. Gurley, Troy, N.Y. The new edition again includes an almanac listing 28 selected stars for determining stellar observations, and contains charts for the sun and Polaris, as well as definitions of astronomical terms and many sample problems. Free copies of the 100-page booklet will be sent, upon request, to practicing surveyors and engineers and to instructors and students of surveying.

Painting Steel. Issuance of the first of two volumes of the *Steel Structures Painting Manual* is announced by the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh 13, Pa. Entitled "Good Painting Practice," the volume describes the best of the current surface preparation and painting practices in various industries. Volume 2, to be issued shortly, will include all the types of important paint systems that give good results in the industries studied, as well as an indexed guide to the selection of suitable systems for various types of structures and exposure conditions.

(*Continued on page 92*)

New Publications

(*Continued from page 91*)

"Good Painting Practice" consists of 432 pages, and is case bound in leatherette with hard covers. Copies may be ordered from the Council at $6 each.

Traffic Safety. A survey of what the states have been doing to improve their traffic safety organization and planning is reported by Maxwell Halsey, executive secretary of the Michigan State Safety Commission, in a recent publication of the Eno Foundation for Highway Traffic Control entitled *State Traffic Safety—Its Organization, Administration, and Programming*. The 280-page book sets forth the what, how, and why of organization, and describes successful safety projects. Explanations are sufficiently detailed to enable the safety director of any state to adapt a plan to his own area with necessary local adjustments. Inquiries should be sent to the Eno Foundation, Saugatuck, Conn.

Mortar Research. An account of studies of several mortars with respect to their bonding strengths to four types of stone, dimensional changes under three conditions of storage, and frost resistance constitutes the National Bureau of Standards Building Materials and Structures Report 139, prepared by Daniel W. Kessler and entitled *Studies of Stone Setting Mortars*. Copies sell for 20 cents each, and may be ordered from the Government Printing Office, Washington 25, D.C.

Air Pollution. As part of its long-range program to eliminate air pollution resulting from industrial processes, the Manufacturing Chemists' Association is publishing Chapter 10 of its Air Pollution Abatement Manual. The current installment, which is prepared by R. J. Jenny, of the American Cyanamid Co., deals with gas and vapor abatement. The 29-page booklet may be purchased from the Manufacturing Chemists' Association, Woodward Building, 15th and H Streets, N.W., Washington, D.C. The 60-cent charge includes postage.

Highway Research. The research work being conducted in the United States in the bituminous paving field is effectively summarized by Ladis H. Csyani, M. ASCE, as Engineering Report No. 17 of the Iowa Engineering Experiment Station. The two articles constituting the report were originally presented at a joint meeting of the German Road Builders and the Asphalt and Tar Division of the German Road Research Association in Germany in May 1953. Inquiries should be addressed to the Iowa Engineering Experiment Station, Ames, Iowa.

Soil Studies. Soil-cement testing and construction are reviewed by the Portland Cement Association in a practical 21-page booklet entitled *Essentials of Soil-Cement Construction*. Inquiries should be addressed to the Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.

Sewage Service Charges. Up-to-date information on sewage service charges in the larger cities of the United States has been compiled by the American Public Works Association in Special Report No. 18. The 35-page bulletin replaces Bulletin No. 7 on Sewer Rentals, which was first published by the association in 1939 and revised in 1941. A total of 581 municipalities of over 5,000 population is listed in the report, which also gives comparative monthly residential charges based on uniform conditions for over 200 cities. Copies may be ordered from the APWA at 1313 East 60th Street, Chicago 37, Ill. The price is $2 a copy, with a 10 percent discount available if payment accompanies the order.

Structural Engineering. A paper entitled "Slender Segmental Arches as Single Dams or as Combined Systems of Dams"—written by Djordje Lazarevic, professor of civil engineering at the High Technical School of Belgrade, Yugoslavia and published by the Serbian Academy of Science—is available for reference in the Engineering Societies Library. The paper, which is summarized in English, consists of two parts. The first part deals with the structural analysis of slender arches applied to dams, while the second part contains a condensed analysis of the possibilities of applying a number of consecutive slender segmental arches. The application of such a system of combined arches to Boulder Dam is discussed, and the conclusion advanced that it would have yielded an appreciable saving on the project.

Welding. An educational lecture series on the fundamentals of the inert-gas shielded metal arc welding process—presented at the 1953 annual meeting of the American Welding Society—has been made available in a special 30-page pamphlet that sells for $1. Copies may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N.Y.

Soil-Cement Testing. Procedures that will greatly reduce the amount of work normally required in testing soils for soil-cement pavement construction are set forth by the Portland Cement Association in a twelve-page bulletin entitled *Short-Cut Soil-Cement Testing Procedures for Sandy Soils*. Single copies are available without charge in the United States and Canada on request to the Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.

Surveying. Publication of the 1954 edition of *Solar Ephemeris and Polaris Tables* is announced by C. L. Berger & Sons, Inc., 37 William Street, Boston 19, Mass. The 96-page booklet contains complete instructions for determining azimuths from the sun and the altitude of Polaris, prepared by Herman J. Shea, associate professor of surveying, Massachusetts Institute of Technology. A limited number of copies are available from the company at 50 cents each to cover handling and mailing.

Hydraulic Research. The manifold problems of transport, scour, deposition, and measurement of sediment are studied in the recent Bulletin No. 34 in the State University of Iowa Studies in Engineering—the proceedings of the Fifth Hydraulics Conference sponsored by the Iowa Institute of Hydraulic Research. Inquiries should be addressed to the Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City, Iowa.

ENGINEERING SOCIETIES

PERSONNEL SERVICE, INC.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

FOUNDATION ENGINEER; M. ASCE; 42; BSCE; New York registration; 18 years' engineering experience comprising executive, projects planning, structural design, estimating and field work. Seeks responsible position with a contractor, consulting or industrial firm. Location preferred, New York metropolitan area. C-923.

CIVIL ENGINEER; A.M. ASCE; 32; married; BSCE, Kentucky registration; 11 years' diversified experience in design, construction, administrative engineering; extensive work in contract management. Available in April upon release from Civil Engineer Corps, U. S. Navy. Desires permanent responsible position with construction, consulting or management engineering firm. Prefer East Coast. C-924.

CIVIL ENGINEER; J. M. ASCE; MCE; Professional Engineer; 31; married; teaching experience; 11 years of diversified responsible experience in structural and foundation engineering, including bridges, turnpikes, buildings, railroads, aircraft. Desires teaching position in eastern university for the fall of 1954 in structural engineering and allied subjects. C-925.

GENERAL MANAGER, CHIEF ENGINEER, RESEARCH DIRECTOR OR SALES MANAGER; A.M. ASCE; 34; experienced in metals fabrication, production machining, government contracts, labor relations, management functions. Prefers southern location C-926.

CONSTRUCTION MANAGER; M. ASCE; 48; married; New York registration; wide experience in planning, coordinating and directing construction of industrials, public works, transportation facilities for contractors and engineers in management capacity. Interested in career job offering economic security. C-927-5312-A-5-San Francisco.

CIVIL ENGINEER; J.M. ASCE; 28; married; veteran; BSCE; registration pending outcome of examination in Illinois; 5 years' experience heavy construction, survey, layout, inspection, office computation, hydrologic investigations, familiar with highway design and construction, reinforced concrete, structural steel building construction. Location preferred West or West Coast. C-928-541-A-1-San Francisco.

CIVIL ENGINEER; A.-M. ASCE. 46; married; 12 years' experience in all climates on layout and construction of concrete buildings, harbor development including dredging, municipal utilities, airports, railroad and highway location and construction. Available immediately for foreign or domestic work. C-929.

Positions Announced

SALES ENGINEERS, 24–30, engineering degree desirable; previous sales experience not necessary. Established national concern selling prefabricated metal products to engineering and construction markets. Complete training program; car furnished; salary and bonus. Territory, Pittsburgh, Pa. Y-8588.

CIVIL ENGINEER, graduate, with 5 to 10 years' general surveying experience with heavy exposure to property surveys. Company engaged in photogrammetric engineering and cadastral mapping service. Write full particulars including education, availability, experience, career objectives and salary requirements. Location, northeastern United States. Y-9292.

CONSTRUCTION COST ESTIMATOR, age 30, with some tax and accounting background for preparation and review of property tax returns and payment reviews, and also to interpret property tax laws, court decisions and administrative rulings. Some traveling. Salary, $5,000 a year. Location, New York, N.Y. Y-9298.

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering, preferably with M.S. degree and practical or teaching experience; major interest in fluid mechanics. Position starts fall 1954. Location, Indiana. Y-9307.

CONSTRUCTION SUPERINTENDENT, 35–40, civil graduate, with general building experience and considerable reinforced concrete housing construction for permanent position with general contractor. Salary, $8,000–$10,000 a year plus bonus. Location, western New York State. Y-9330.

INSTRUCTOR OR ASSISTANT PROFESSOR in sanitary engineering; M.S. desired, but not required; to teach undergraduate sanitary engineering courses and to do research in sanitary industrial fields; 11 months' service. Position starts February 1, 1954. Salary commensurate with training and experience. Location, Pacific Northwest. Y-9336.

ASSISTANT CITY PLANNER with college training in city planning, engineering or both. Several years' experience in zoning, mapping and land subdivision. Salary, $5,650 a year with four annual increments of $150 a year. Location, upstate New York. Y-9337.

PROFESSOR in civil engineering. Duties involve the teaching of such courses as surveying, structural design and sanitary engineering. Position open to recent graduates. Salary and academic rank open depending on degree and experience. Location, Kansas. Y-9339.

GRADUATE AND RESEARCH ASSISTANTS in civil engineering department. Will do half time research work or assist in the instruction in the following fields: structural steel, prestressed concrete, hydraulics, materials testing laboratory, engineering drawing. Should obtain M.S. in 2 years. Salary, $120 a month plus tuition. Location, Middle Atlantic states. Y-9432.

CHIEF DRAFTSMAN, structural engineer, fully qualified to take complete charge of drafting department of about 30 men for a structural steel fabricating plant. Must have gained experience with a fabricating concern. Location, North Central states. Y-9469.

CIVIL ENGINEER with sanitary engineering experience covering water works, pipelines or municipal engineering. Knowledge of Spanish desirable. Salary, $6,000–$8,000 a year. Location, Columbia, S.A. F-9478.

SANITARY ENGINEER, licensed or eligible for examination for license to practice professional engineering in New York State. Degree in sanitary or public health engineering and 4 years' public health engineering experience; or degree in civil or chemical engineering and 6 years' public health engineering experience; or any combination of education, experience and training which is determined to be the equivalent of either of the above. Location, New York State. Y-9497.

RESIDENT ENGINEER with at least 10 years' construction experience covering mill type and metal manufacturing plants. Salary, $8,000 a year plus $10 per diem expenses. Location, Southern Illinois. Y-9511.

HEAD OF CIVIL ENGINEERING DEPARTMENT, under 55, with M.S. or Ph.D. degree and 10 years' teaching experience, to take charge of department, teach structures and strength of materials. Immediate appointment. Apartment or heated house on campus at reasonable rent. Salary, $6,000–$6,500 a year. Location, northern New England. Y-9527.

CONSTRUCTION SAFETY ENGINEER with at least 3 years' multi-story fireproof building construction experience covering accident prevention, and general safety work. Salary, $5,000–$6,000 a year. Location, New York, N.Y. Y-9543.

ESTIMATOR for heavy construction, to handle bidding. Give résumé of experience. Location, New York, N.Y. Y-9553.

ARCHITECTURAL ENGINEER, 40–45; 15 years' minimum experience in building construction as engineering designer and building architect. Should have B.S. degree in architecture, architectural engineering, or civil engineering. Should be registered architect with knowledge of building engineering, design, construction and alteration. Drafting plans and setting up specifications. Coordination and direction of construction work. Salary open. Location, New Jersey. Y-9562.

ARCHITECT'S REPRESENTATIVE to call on architects, engineering firms, contractors and industrials with regard to special and ultimate use of vermiculite. Salary, $4,000–$6,000 a year. Location, New York, N.Y. Y-9576.

Positions Announced

City of Los Angeles. The position of Civil Engineering Assistant at a salary ranging from $395 to $489 a month is now available with the City of Los Angeles. Graduation from a recognized four-year school of engineering in a college or university or possession of an engineer-in-training certificate issued by the State Board of Registration for civil and professional engineers is required. College seniors may also file for this unwritten exam. Applications, obtained from the Los Angeles City Civil Service Commission, City Hall, must be filed in person or sent by mail to Room 5, City Hall, Los Angeles, Calif.

The Engineer Center. Announcement is made by The Engineer Center at Fort Belvoir, Va., of several openings for Bridge Engineers at annual salaries ranging from $3,410 to $5,940 and for Civil Engineers at salaries from $3,410 to $5,060. Federal Employment Standard Form 57 may be obtained from any Civil Service or Department of the Army civilian personnel office, and should be mailed or brought in person to the Civilian Personnel Branch, Employee Utilization Section Building 211, Room 200A, The Engineer Center, Fort Belvoir, Va.

San Diego County. Availability of positions as Engineer III (highway engineering option) carrying with it a starting salary of $483 per month is announced by San Diego County. Applicants must be males; 25 to 55 years of age; citizens of the United States; and must have a college degree or its equivalent in field or administrative experience. The examination will consist of a written section and an appraisal of the applicant's background.

Third Naval District. An opportunity as Fire Prevention Engineer—starting salary, $5,940—is announced by the District Public Works Office of the Third Naval District, in New York City. Minimum requirements include engineering degree from an accredited college, or four years' equivalent technical experience, and three years of progressive field engineering experience. Further information may be obtained from the District Public Works Officer, Room 633, 90 Church St., New York, N.Y.

Solution to problem on page 40

The pump pit was placed back in alignment by flotation—the very same manner in which it had gotten out of alignment. Water was pumped from the pit into the surrounding excavation. A cable sling was then placed around the pit and it was pulled into place with a tractor. To settle the pit again, water was pumped into it from the surrounding excavation.

RECENT BOOKS

Introduction to Aeronautical Dynamics

Intended as a two-semester course for undergraduates, this text by Manfred Rauscher provides a thorough coverage of particle dynamics, fluid dynamics, airfoil theory, rigid dynamics, and vibration analysis. The detailed analytical treatment is kept within the range of the students mathematical background, the main object being to lay a solid foundation, along with the applied courses, for the subsequent study of aircraft stability. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1953. 664 pp., $12.)

Practical Design of Simple Steel Structures, Volume II

The second volume of David S. Stewart's detailed text and guide for students and practising engineers covers major structural elements such as girders, columns, and trusses, and complete bridge structures. Full design calculations, presented as in the design office, are carried out for the following: 40-foot span gantry girder; 55-foot roof truss; lattice girder foot bridge; 70-foot span through railway bridge; 70-foot Pratt truss highway bridge. Detailed drawings are included. (Constable & Company Ltd., London, 3rd edition, 1953. 297 pp., 25s.)

Prestressed Concrete

This is a free translation of Guyon's comprehensive treatise on prestressed concrete, covering fundamental concepts, basic methods of construction, materials, analysis and calculations of prestressed units with different types of reinforcements and under various conditions, methods of investigating cracks and failures, and determination of safety factors. To broaden the book's value, worked examples and some test results have been recast using British dimensions. W. M. Johns is the editor. (John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1953. 543 pp., $12.)

Eisenbahnbrucken aus Spannbeton

This report (Deutscher Ausschuss für Stahlbeton, Heft 112, by Reichsbahnrat Bührer) on experiences in the construction of prestressed concrete railroad bridges presents the results of tests and measurements made on four existing structures and on test pieces. Tables and graphs are extensively used in the presentation of the data. (Wilhlem Ernst & Sohn, Berlin, 1953. 67 pp., DM 8.00.)

Housing and Building in Hot-Humid and Hot-Dry Climates

The four sessions of this conference dealt respectively with the following subjects: the problem of living in hot environments; architectural design for hot climates including bioclimatic requirements; structural features and the performance and properties of materials; mechanical problems such as cooling and dehumidification. Many of the papers in this Research Conference Report No. 5 present considerable detailed technical information. (Building Research Advisory Board, 2101 Constitution Ave., Washington, D.C., 1953. 177 pp., $6.)

Beam Formulas

Originally intended for use in connection with A. Kleinlogel's other books, this compilation translated by Harold G. Lorsch is also of independent value for the computation of statically determinate and indeterminate structures. It contains more than 70 loading conditions covering the range of loads in practical engineering. This American edition contains elastic curve equations and other material not given in the original German. (Frederick Ungar Publishing Company, 105 East 24th St., New York 10, N.Y., 1953. 143 pp., $5.50.)

Cambridge Elementary Statistical Tables

D. V. Lindley and J. C. P. Miller have prepared a set of ten tables of the commoner statistical functions and tests of significance for users of statistical methods in scientific research, technology, and industry. Tables included are for the normal distribution and frequency functions, percentage points of various derivations of the normal distribution, the correlation coefficient and other common transformations, and random sampling numbers. (Cambridge University Press, 32 East 57th St., New York 22, N.Y., 1953. 35 pp., $1.)

Design and Construction of General Hospitals

Summarized results of research by various associations and other authorities in the public health field has been prepared by the U.S. Public Health Service. Its importance to engineers and architects lies in the detailed treatment of structure and layout planning, mechanical and electrical equipment, site problems, costs, and specialized construction requirements. Master plans are provided for various sizes of hospitals. (F. W. Dodge Corp., 119 West 40th St., New York 18, N. Y., 1953. 214 pp., $12.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

Non-ASCE Meetings

American Concrete Institute. The 50th anniversary of the founding of the American Concrete Institute will be celebrated at its 1954 annual meeting, to be held at the Shirley-Savoy Hotel, Denver, Colo., February 22–25.

American Concrete Agricultural Pipe Association. The fourth annual convention and meeting of the American Concrete Agricultural Pipe Association will take place at the Fairmont Hotel, San Francisco, February 24.

American Concrete Pipe Association. Headquarters for the 46th annual convention and meeting of the American Concrete Pipe Association will be the Fairmont Hotel, San Francisco, February 25–27.

American Institute of Chemical Engineers. The Statler Hotel, Washington, D.C., will be headquarters for the meeting of the American Institute of Chemical Engineers, March 8–10.

American Institute of Electrical Engineers. Trends in computers, with emphasis on their use in business, industry and aircraft control, will be the theme of the Western Computer Conference sponsored by the AIEE, at the Ambassador Hotel, Los Angeles, February 11 and 12.

American Institute of Mining and Metallurgical Engineers. Annual meeting at the AIME will be held at the Hotel Statler, New York, N.Y., February 15–18.

American Society for Metals. Mid-Winter Meeting of the American Society for Metals will be held at the Hotel Statler, Boston, Mass., March 4 and 5.

Illinois Highway Engineering Conference. The 40th annual Illinois Highway Engineering Conference will meet on the campus of the University of Illinois, Urbana, Ill., March 2–4.

National Association of Corrosion Engineers. The tenth annual conference and exhibition of the National Association of Corrosion Engineers will be held in Kansas City, Mo., March 15–19.

National Conference on Trichinosis. The Second National Conference on Trichinosis will be held in the auditorium of the American Medical Association, 535 North Dearborn St., Chicago, Ill., March 1.

Northwest Conference on Road Building. The civil engineering department at the University of Washington, Seattle, Wash., is sponsoring the Seventh Northwest Conference on Road Building, to be held at the university (214 More Hall), February 17–19.

Society of Automotive Engineers. A meeting of the Society of Automotive Engineers, devoted to the passenger car (body and materials) will be held at the Hotel Statler, Detroit, Mich., March 2–4.

New in Education

This fall engineering entered the field of adult education via television. Six engineering professors from the University of Michigan College of Engineering presented a series of 15 one-half hour programs entitled "Engineering: Building the Modern World." Produced by University of Michigan Television, the program was carried by three studios in Detroit, Lansing, and Kalamazoo. Those interested in more details were referred to the University of Michigan Extension Service.

Research activity in the New York University College of Engineering increased 14 percent during 1953 and passed the $2,000,000 mark. The annual expenditure for sponsored research was $2,017,000, compared with $1,758,000 the previous years. The recently released annual report describes the Division's wide range of investigation—from establishment of a cosmic ray observatory on an Alaskan mountain to electronic research and development in the specialized fields of transmission measuring equipment, servomechanisms, and power generation, and research in air and water pollution.

The department of engineering mechanics at the University of Detroit recently installed equipment for use in research involving hydraulic pressures up to 25,000 psi and for the calibration of pressure gages of all sizes and capacities up to 25,000 psi. Inquiries concerning the equipment, available to industry for research problems, should be addressed to the Engineering Research Council or H. E. Mayrose, chairman of the Department of Engineering Mechanics, University of Detroit, Detroit, Mich.

The Traffic and Planning Division of the Mississippi State Highway Department at Jackson, is sponsoring a series of five-week "in service" training courses in photogrammetry. The course is planned to give highway engineers the basic know-how for highway engineering purposes, of the identification of images on aerial photographs and their interpretation by stereoscopic examination, and by making measurements by elementary photogrammetric methods for reconnaissance purposes.

A short course for sewage treatment work operators will be given by the Massachusetts Department of Public Health at the University of Massachusetts, Amherst, Mass., March 22–26. Inquiries should be addressed to the Division of Training, Massachusetts Department of Public Health, 543 State House, Boston, Mass.

The Armour Research Foundation has been selected by the Midwestern Air Pollution Prevention Association to carry out a $25,000 study to combat air pollution in the Chicago area. In an address before the association's fall meeting in Gary, Ind., Dr. H. A. Leedy, director of the foundation and president of MAPPA, detailed MAPPA's three-point program, given here:

1. A study to determine the sources of pollution.
2. The study and analysis of a large number of cases histories of smoke violations in the files of the city's Air Pollution Control department.
3. An education program to inform Chicago residents of the problem and how it can be controlled.

Scientists at the Armour Research Foundation were scheduled to have begun this study to improve the atmosphere around Chicago in November.

The School of Civil Engineering of Cornell University announces the establishment of a two-year fellowship for graduate study in the use of bituminous materials and aggregates for bituminous paving mixtures. The fellowship has been made possible by the New York State Bituminous Concrete Producers Association. Applicants for the 1954 spring term are now being considered. Information may be obtained from Prof. Taylor D. Lewis, Lincoln Hall, Cornell University, Ithaca, N.Y.

Contracts totalling $1,195,087 have been let by the University of Pittsburgh for the construction of a building to serve as new headquarters for its schools of engineering and mines. A sharp rise in freshman enrollment, combined with increasing support from industry makes the facilities doubly necessary, according to Dr. Raymond Fitterer, dean of engineering and mines. The new engineering building, on the Oakland campus, will be six stories high with a total floor area of 61,300 sq ft. It will house research and laboratory space, the hydraulics, strength of materials, soil, and chemical engineering laboratories. The wind tunnel for aeronautical engineering will also be housed in a section of the building. Work was begun early in November.

Considerable activity is under way in universities relative to instituting courses on corrosion, according to Dr. Norman Hackerman, University of Texas, chairman of the National Association of Corrosion Engineers' education committee. Among the universities considering or giving courses in corrosion are Stevens Institute of Technology, Oklahoma A & M College, Washington State College, and the Universities of Tennessee, Missouri, Houston, Oklahoma and California (at Berkeley).

Industry, engineering societies, and the University of Cincinnati recently cooperated with the Engineer's Council for Professional Development in the presentation of a highly successful community project. A total of 285 practicing engineers and scientists enrolled in the expanded group of graduate courses offered this year for the first time on a part time basis through the joint plan of the Evening College and the Graduate School of Arts and Sciences at the University of Cincinnati.

Applications for Admission to ASCE, December 12, 1953–January 9, 1954

Applying for Member

Frank Neale Barker, Chicago, Ill.
Hubert E. Brooke, Santa Fe, Calif.
Hugh Clifford Clarke, Jersey City, N.J.
Albert Howard Clayton, Austin, Tex.
Stephen Curtis, Pittsburgh, Pa.
Naladurgia Srinivasa Govinda Rao, Bangalore, India.
William Richard Gray, Cleveland, Ohio.
Clyde Clemont Johnson, Toledo, Ohio.
Theodor Kaplun, Haifa, Israel.
Thomas Herman Kuhn, Jamaica, N. Y.
Thomas Leslie Lowe, Cardiff, Great Britain.
James Jenkins MacDonald, Buffalo, N.Y.
Reginald Adams McFarland, Ruston, La.
George Hartmus Nelson, Atlanta, Ga.
Elmer Jacob Niemen, Columbia Falls, Mont.
Franz Anton Poepel, Stuttgart, Germany.
Carl Emanuel Roberts, Fort Worth, Tex.
Erwin Gustav Rusch, Brookfield, Ill.
Herbert Nason Skolfield, Ellsworth, Me.
Donald Russell Stanley, Edmonton, Alberta, Canada.
John Guice Sutton, Washington, D.C.
Loval Mullen Van Doren, Topeka, Kans.
Leonard Van Houten, New York, N.Y.
Roberto Vianna Rodriguez, Denver, Colo.

Applying for Associate Member

Joseph Michael Busalacchi, New York, N.Y.
William Herbert Cook, Long Beach, Calif.
Willard Warren Dean, Sacramento, Calif.
Marcial Cuellar-Peralta, Bogota, Columbia, S.A.
Jose Antonio Faria-Mendoza, Venezuela, S.A.
Clarence Freeman, New York, N.Y.
Howard Wallace Holmes, Providence, R.I.
George Hondros, Nedlands, Western Australia.
Rex Houchin, Little Rock, Ark.
Allen Patterson Hundley, Jr., Dallas, Tex.
Virgil Calvin Jewell, Santa Fe, N.Mex.
Waryam Singh Jagdev, Mombasa, East Africa.
Edwin Arnold Kapernick, Billings, Mont.
Edward James Labrie, Stockton, Calif.
Dev Prakash Mehta, Delhi, India.
John Harvey Neilsen, Milwaukee, Wis.
Fouad Abdel Rahman Osman, Ithaca, N.Y.
Joseph Russell Passonneau, Knoxville, Tenn.
Joseph Frank Perna, Jr., Washington, D.C.
Randolph Joseph Petersen, Baltimore, Md.
Francis Lewis Rees, Arkansas City, Kans.
Albert Kimball Roberts, Wilmington, Del.
John Henry Reid, New York, N.Y.
Morris Schupack, Arlington, Va.
Arnold Remington Smith, Syracuse, N.Y.
Robert Milton Swift, Caracas, Venezuela.
Raymond Ernest Untrauer, Fayetteville, Ark.
Clarence Georok Watters, Jr., La Mesa, Calif.
Claud Bert Williams, Anchorage, Alaska.

Applying for Junior Member

Jose Eduardo Acuna-N, Laramie, Wyo.
Aftab Alam, Iowa City, Iowa.
Henrique Brenner, Sao Paulo, Brazil.
John Edward Bunts, Denver, Colo.
Luis Rafael Canetti, Cambridge, Mass.
John Curtis Commander, Monterey Park, Calif.
Charles Howard Corning, Columbus, Ohio.
Peter George Corriveau, Detroit, Mich.
Andre Jean-Jacques Deville, New York, N.Y.
Clarence Howell Fosler, Detroit, Mich.
Robert John Gambino, West Haven, Conn.
Arthur Curtis Gooch, Sacramento, Calif.
John Leater Haff, Omaha, Nebr.
Jeryl Drannon Hart, Dallas, Tex.
Nathan Herszberg, New York, N.Y.
Del Mar Janson, Sacramento, Calif.
Richard Walter Krotz, Cleveland, Ohio.
Albi at Elmer Lewis, Jr., Sacramento, Calif.
Thomas Joseph Lynch, Menlo Park, Calif.
James Aller Norris, Seaford, Del.
Louis Arthur North, Philadelphia, Pa.
William Lee Pattillos, El Sejundo, Calif.
Allan Wallace Petterson, Alberta, Canada.
Kasi Gopala Radhakrishan, Madras, India.
Rodney Walter Ripley, St. Paul, Minn.
Robert William Schneider, Terre Haute, Ind.
Milton LeRoy Schaffer, Detroit, Mich.
Manohar Singh, Rangoon, Burma.
Carroll Ellis Taylor, Philadelphia, Pa.
Leonard Erskine Van Houten, New York, N.Y.
Willis Albert Waas, Kansas City, Mo.
Richard Wainer, Cuiver City, Calif.
Gerd Friedrich Weissmann, Summit, N.J.

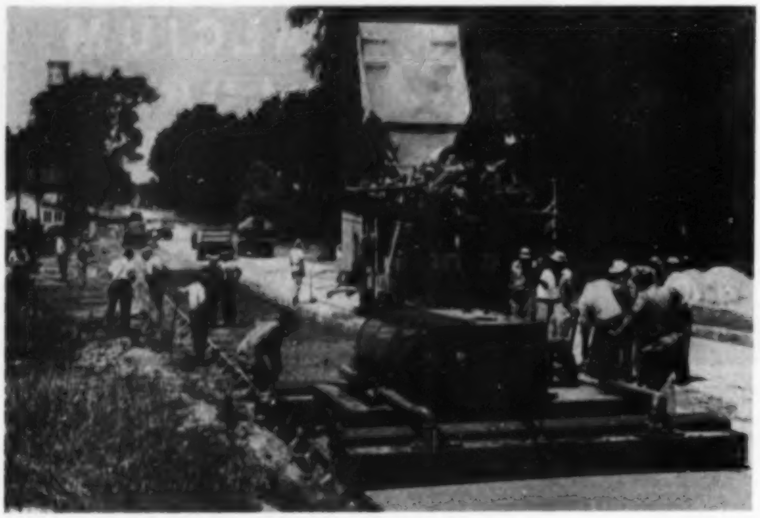
[*Applications for Junior membership from ASCE Student Chapters are not listed.*]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Hydraulic Finishing Machine

THE FLEX-PLANE hydraulic finishing machine is the first concrete road building machine to incorporate the benefits of complete hydraulic action. Essentially, the machine does two things; it greatly increases the quality of the finished concrete; and it greatly increases the speed at which concrete pavements can be finished. In addition, this machine also incorporates other important features—its complete portability, its faster width adjustability, and simplicity and ease of operation. The screeds are hydraulically reciprocated. This takes the place of the rotary screed drive action of mechanical machines. The rotary screed drive of mechanical machines is not completely efficient in that the screeds are raised very slightly at the end of each stroke. In addition, at the end of each stroke, the screeds "pause," which creates a dragging action—slight as it may be. These two seemingly insignificant conditions are responsible for slower, less efficient and more expensive hand finishing operations. The piston activated hydraulic finishing machine eliminates both of these undesirables. The activating element—the hydraulic piston—operates in a horizontal plane. This insures that the screed is in perfect contact with the concrete throughout its complete cycle. In addition, because of its piston action, there is no slowing of the screed traverse; thus, there is no screed drag. Practically, the evidence of this superior finish has been demonstrated on the 15 State Highway test jobs, on which the machine performed. On some of the test jobs bullfloating was eliminated because the machine left such a true finish. On every test job the hand finishers worked much closer to the machine because of the easy work left for them by the machine. In working super-elevated curves, the superiority of the hydraulic screed action became even more evident. The Flex-Plane machine held the concrete at the high form. Concrete did not roll toward the lower form line. This feature alone eliminated carry-back of material to the high form. The speeds at which this machine operate are one of the secrets contributing to the improved quality of the finish. The normal mechanical machine is limited to only three screed stroke combinations. The hydraulic screeds operate from 0 to over 100 strokes per min. In addition, the front and rear screeds are independently operated and controlled to conform to job conditions. This means that an infinite number of combinations of travel and screed speeds are immediately available to the operator by simply dialing the speed desired. In addition, the forward and reverse travel speeds are approximately $2^1/_2$ times faster than mechanical machines. Perhaps, more important than the speeds is the fact that the hydraulic range of speeds is selective at any point between 0 and 220 ft per min. In contrast to this almost infinite selection, the mechanical machines are limited to only four pre-determined speeds. This combination—faster screed speeds and faster travel—enables the contractor to adapt the finishing operations to variable job conditions. **Flexible Road Joint Machine Co., CE 2-100, Warren, Ohio**



Flex-Plane Has Complete Hydraulic Action

Building Material

TECTUM IS A building material made of wood fibers bonded together with an inorganic cement. It is being used for commercial, industrial and school roofs. Claimed to be structurally stronger, in many ways, than plain concrete, it has a very high insulating value, possesses excellent acoustical properties and has passed Underwriters' Laboratories tests for incombustibility. In the Newark, Ohio, plant of the Tectum Corp., wood fibers are fed into one end of a large roller-oven. Chemicals are added and a city block down the line, a continuous slab of roof plank rolls off. The material is incombustible, doesn't rot, weaken with age, or appeal to a termite. It can be sawed, chopped, or drilled. Many experiments are being made with the product. It may soon be used as the wall core in a new line of metal houses. It is being tried for interior wall partitions and has real possibilities in the field of radio and television. The acoustical treatment is built into the wall when the product is used. Since it is made from shredded wood, small pieces could be used. The principle could prove a lumber stretcher for the nation's supply. **Tectum Corp., CE 2-100, 105 South Sixth St., Newark, Ohio**

Catalytic Reduction Process

A NEW PROCESS which completes biological sludge digestion in one-quarter of digester volume generally required, has been announced. This means that the capital expenditures for the digestion stage in sewage and industrial waste treatment plants may be drastically cut. Because of rapid population increases since the war many existing plants have seriously overloaded digesters. The use of the process will make existing tank capacities sufficient to carry the new load. It is possible to complete the anerobic decomposition of sewage solids in approximately one-third to one-fourth the time currently considered necessary. Operation over a period of four years has indicated that loading ratings of 0.345 lb of volatile solids per cu ft of digester volume per day can be successfully digested. This contrasts with 0.05 lb of volatile sewage solids per cu ft of digester volume per day usually found in sewage treatment plant operations. The sludge produced is the equal in every respect to sludge produced by currently practiced digester operation methods. These findings have been verified in full scale plant operation at Columbus, Ohio. The process known as Catalytic Reduction Process is being offered for consideration to consulting engineers and municipalities through the Catalytic Reduction Co., Inc., a subsidiary of the **Chicago Pump Company, CE 2-100, 622 Diversey Pkwy, Chicago 14, Ill.**

Equipment, Materials & Methods (Continued)

Hydraulic Crane

A NEW HYDRAULIC CRANE combines the best features of crawler, truck and erection cranes with those of industrial shop cranes. It can lift and transport its maximum load any distance indoors or outdoors; with boom extended, hook can be raised 24 ft or lowered 30 ft below ground level. The telescopic boom can be raised to any point between the horizontal and 45 deg and can be turned continuously through 360 deg. Load performance tests showed that the crane operated with a much greater degree

of efficiency after changing from the conventional type worm gear to the present Cone-Drive gearset. This exceptional efficiency rating was achieved through use of a standard 6 in. center distance 50:1 Cone-Drive gearset in the boom lifting mechanism, which is driven by a 750 rpm Vickers hydraulic motor. A second Cone-Drive gearset, with a 5 in. center distance and 40:1 ratio, is used on the crane swing drive to provide smooth operation and save both space and costs. Rated capacity of the crane is 3,200 lbs at a boom radius of 18 ft, and 8,000 lbs at a 10 ft boom radius. **Austin-Western Company, CE 2-101, Aurora, Ill.**

Clinometer

THE GEO-POCKET Clinometer is designed for reading vertical and horizontal angles in preliminary surveys. It also serves for the determination of distances. Therefore, it is useful to surveyors, civil engineers, mining engineers, building contractors, foresters and architects. The instrument will render excellent service to the surveyor for measurements in close and intersected terrain, as well as for surveying steep roads where it is difficult to work with regular types of surveying instruments. Every surveyor and civil engineer should carry this instrument because of its handiness for sighting points and for checking possible measuring errors. It is also an excellent instrument for architects and contractors to determine the measurements required for estimating the cost of building projects. If handled carefully, it will also serve for precise measurements of distances and elevations, or for surveying profiles. **Geo-Optic Company, Inc., CE 2-101, 170 Broadway, New York 38, N.Y.**

Equipment, Materials & Methods (Continued)

Road Sweeper

A RECENTLY designed, practical and efficient non-electric magnetic road sweeper is now offered. Nails, wire and other ferrous hazards to rubber-tired traffic on roads, airports and loading areas are quickly removed by this revolutionary sweeper. Heart of the Cesco magnetic road sweeper is its set of Alnico high intensity magnets with a lifetime

magnetic service guarantee. Available in standard sweeping widths of from 4 to 8 ft, these magnetic road sweepers are supported on cold rolled steel frames with 16 in. heavy duty road-type wheels mounting pneumatic tires. Wider models are available on special order. The complete sweeper includes stainless steel magnetic plate covers that dump collected tramp iron into the built-in retainer pans. This operation is easily and quickly accomplished by a manually operated worm gear that serves to rotate the magnets to the discharge position. The stainless steel covers are then swung upwards and immediately release their loads into the retainer pans. The hitch of the Cesco magnetic road sweeper is designed for attachment to a Jeep, tractor or any other vehicle that will pull it over the area to be swept. These non-electric, permanent sweepers cost nothing to operate and are ready for work at all times. They function in all kinds of weather and cannot cause shock to users or sparks to endanger plants handling inflammables. They operate efficiently on both smooth and unpaved areas. **Cesco, Div. 15, Santa Rosa, Calif.**

Plastic Pipe

LATEST DEVELOPMENTS in a new type of plastic pipe indicate that the thermosetting (heat-set), rigid, glass-fiber, reinforced plastic polyester resin pipe is already in widespread use in many applications previously thought suitable only for steel. Reflin pipe has aroused widespread interest among pipemakers who view it as a product which may replace steel pipe for corrosion-service uses. The pipe has overcome many of the limitations of presently used plastic pipe materials which previously have limited the widespread acceptance of plastic pipe. It is available in larger diameter (ranging from 4 in. up to 10 in.) is stronger, tougher, lighter and has greater temperature range of operation (from −90 deg F to −230 deg

(*Continued on page 103*)

Equipment, Materials & Methods (Continued)

F). It is nearly chemically inert and has no tendency to cold-flow. While it has many of the advantages of steel pipe, Reflin pipe scores higher in easier handling and lower cost of installation and maintenance. And unlike metal pipe it is resistant to rust, chemical attack, electrolytic action and other factors causing deterioration of metal pipe. While steel pipe fails through corrosion in from 3 to 4 years, and gray iron with good corrosion resistance will last 10 years, Reflin pipe will resist corrosion indefinitely. The superior qualities of the glass-fiber reinforced material provide many advantages for pressure transmission applications. Resistant to most salts, acids, hydrocarbons and natural corrosive elements commonly found in pipeline applications, Reflin pipe withstands aging and weathering in above or below ground conditions. **Reflin Co., CE 2-103, Gardena, Calif.**

Front End Loader

A 1 cu yd front end loader with torque converter has been added to the company's front end loader line. Powered by gasoline or diesel, the smaller capacity front end loader joins the $1^1/_2$ cu yd Model 15 Series Speedall with torque converter, which Pettibone made available for national distribution last summer. The torque converter is standard equipment on all Speedall 1 cu yd and $1^1/_2$ cu yd models.

Diesel or Gasoline Powered

The high dump and long reach of the $1^1/_2$ cu yd Speedalls, are also unique features of the 1 cu yd models, coupled with the benefits from torque converter power transmission of extra yardage, higher daily output, faster cycles, less breakage and smoother operation. When the bucket is centered over the truck, 7 ft above the ground, Speedall's front tires are 2 ft away from the truck body. This eliminates loss of time ordinarily required for spotting loaders. Because the torque converter basically depends on the well-established fluid-drive power transmission principle, all Pettibone Speedall models provide inch by inch control through foot acceleration only, without shifting speeds or slipping clutch. The engine operates at maximum efficiency at all times with full power for full loads and just enough power for light loads because power is automatically selected for the load handled. Engine stalling and slow-downs while waiting for engine speed pick-ups are thus eliminated. **Pettibone Mulliken Corp., CE 2-103, 4700 West Division St., Chicago 51, Ill.**

Equipment, Materials & Methods (Continued)

Scaffolding Bracket

ENTHUSIASTIC acceptance on the West Coast has encouraged the manufacturers of Clamp-Jack to establish national distribution for this new scaffolding bracket, designed particularly for concrete construction work. Among the reasons offered for its quick popularity are outstanding safety factors, plus time and material saving features. Clamp-Jack is designed so that it will adapt to every step of concrete construction work including: erection of first and second form walls; placing of reinforcing steel; stripping of forms; breaking off ties; patching, sacking and finishing the surface. Safety is assured by the fact that the Clamp-Jack is solidly bolted in place throughout all operations. Even severe jars, bumps or vibrations will not dislodge these supports until they have been unbolted. Time and materials are saved because Clamp-Jack brackets eliminate the necessity and expense of erecting supporting members from the ground up on any phase of the job. Clamp-Jack users report their scaffolding costs are one-fourth to one-third that of the standing type. Clamp-Jacks are easily secured in place by hooking over or through the walers, or by a form clamp and stand-offs on the inner surface of the first form wall when placing reinforcing steel. They are not limited to use on walers, however. After the first section has been poured and stripped, the form clamp may be attached to a "J" bolt or deformed inner rod left imbedded in the concrete. Provisions are built-in for use of standoffs and handrail support. Additional features include light weight (22 lbs) and ease of stacking. **Continental Scaffolding Co., CE 2-104, 4671—24th Street Road, P.O. Box 2551, Sacramento, Calif.**

Rock Bits

A FULL SERIES of carbide-tipped detachable rock bits—which are said to be compiling remarkable footage records on current Canadian mining, tunneling and road constructions projects—will be added to the Coromant drill steel line. The bits will be available in diameters ranging from 1³/₈ in. to 4 in. Field tests on selected Western projects now are under way to compile case history data, and to verify records of Canadian comparative tests which showed the tools to be drilling up to 300 percent more footage. This improvement was the result of a Coromant formula for the carbide insert and also a special Swedish steel used in the skirt and body of the bit. Sandvik, manufacturer of the Coromant line which Copco Pacific distributes exclusively in the West, is unusual in that it operates its own tungsten carbide mines in Northern Sweden, plus all of the processing plants necessary to produce the finished carbide product. This gives an unmatched opportunity for quality control. **Copco Pacific, Ltd., CE 2-104, 930 Brittan Ave., San Carlos, Calif.**

Equipment, Materials & Methods (Continued)

Plastic Drawing Instrument

An interesting plastic drawing instrument for general design work has been placed on the export market. Called the Quickdraw, it enables accurate drawings to scale to be made even by amateur draftsmen being particularly useful where full drawing office facilities are not available. The appliance consists of a light rigid board contained in a leather folder 14 in. square to which is attached a plastic pantograph with a template so shaped as to enable lines to be ruled horizontally, vertically and at all principal angles, including those required for isometric or perspective drawing. The template is also carefully cut with mathematical accuracy to produce varying angles, triangles, and rectangles, with graduations in inches and millimeters and circles from $^1/_{16}$ in. to 1 in. diameter. A wide range of work can be carried out without the need for any additional instruments whatsoever, although it can, where necessary, be used in conjunction with compasses, scales or protractors. It is particularly useful for carrying purposes as the appliance is complete in case, thus saving all the necessary impedimenta of drawing board, T-square, etc. **Quickdraw Company, Ltd., CE 2-105, 127 Gunnersbury Avenue, London W.3, England**

Truck Mixers

Five and six cu yd truck mixers featuring improved weight distribution are announced. The center of gravity has been moved forward and lowered by combining the pedestal and 90 gal water tank. Thus greater payloads are possible on any

10-wheel truck of 175 in. wheelbase or more, yet they are well within legal highway load limits. Power for the mixing drum is supplied by a rear side mounted Chrysler 6 cylinder industrial engine. Equipped with fluid drive, this engine offers exceptional operational control when used with the combination throttle and over-center drum brake which are standard on the Willard mixer. All controls are conveniently located. Improved engineering design provides built-in strength and lightweight throughout frame and drum construction. Easy concrete placement is accomplished with the rachet controlled chute which measures 14 ft when extended. **Willard Concrete Machinery Sales Co., CE 2-105, Lynwood, Calif.**

Equipment, Materials & Methods (Continued)

Weed Killer

CHEMICAL WEED killers are finding more and more use particularly where unwanted vegetation presents a maintenance problem or a fire hazard. High labor costs make grubbing, hand clipping or even power mowing prohibitive for many locations where removal of vegetation is desirable. One of the newest specialists among chemical weed killers is CMU—intended for use where bare ground is the objective. As little as 40 lbs of this chemical per acre, or half a cup per 100 sq ft, will keep ground free of vegetation for one season or longer. It comes as a powder to be mixed with water, forming a suspension, as it is soluble only at the rate of 250 parts per million. It should be applied to the soil when there will be sufficient rainfall to carry the chemical down to the roots. Power spray equipment with agitation is recommended for applying. Low dosage means minimum storage requirements for a season's supply and the compound is non-flammable, non-volatile, and presents no toxicity problem to people, livestock, or wildlife. One safety precaution must be observed—CMU should not be applied where it can reach the roots of shade trees or other plants of value, as it is non-selective when used for general weed control. Some uses in the civil engineering field include roadsides and other public works operations, along plant security fences, in pavement joints and cracks, around fuel storage and equipment yards; around wooden structures and storage areas, such as sheds, bridge trestles, lumber and timber piles; military installations, pole yards, electrical installations, pipe lines, firebreaks, and railroads. Custom applicators are entering the field in many communities, applying weed killers on a contract basis. **Public Relations Department, CE 2-106, E. I. Du Pont De Nemours and Co., Inc., Wilmington 98, Del.**

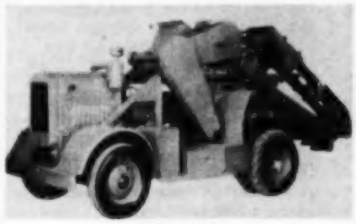
Fork Lift

A UNIQUE off-the-road multi-purpose fork lift has just been announced. A machine of unusual versatility, the Terra-Lift M3 can be converted within 10 min. from a 3000 lb capacity fork lift into a ¾ yd bucket loader, 6 ft angling dozer, or towing tractor of 30 drawbar hp. It will handle materials in deep mud, sand or snow, and is even able to achieve excellent traction on glaring ice. For indoor and outdoor use, the Terra-Lift equipped with hard rubber shoes operates easily over oil-soaked floors, silicon sand, or steel scraps in mills, foundries, and manufacturing plants. Available with 9 ft or 12 ft lifting mast, it is capable of handling gravel, sand, steel, pilasters, brick, or cement blocks from unpaved work areas to second story height. The Terra-Lift has only 6 psi of ground pressure under full load, and is completely equipped with forks, loader, angledozer and tow hook. **American Tractor Corporation, CE 2-106, Churubusco, Indiana**

Equipment, Materials & Methods (Continued)

Trenchmobile

Increased bucket capacity with widths up to 16 in. has been announced, for the Model 88 pneumatic-tire mounted Trenchmobile. The Model 88 is now offered with a choice of three bucket widths; 8, 12, and 16 in. Other improvements include hydraulic boom hoist with positive down crowd and three-point suspension of the wheels from the Trenchmobile frame. With the increased trench width, the range of usefulness of the Model 88 Trenchmobile will be extended. Workers can now get into the wider trench when



Model 88

installing pipes, tiles and conduits. Trenches for larger size pipes, tile and conduit systems are now within operating range of the machine. A wider range of home and building footings can now be excavated. Hydraulic hoisting and lowering of the digging boom provides positive down crowd when setting in the most severe soils. It also maintains grade quickly and accurately. The speed of raising and lowering can be increased and is better controlled by the operator than formerly. Simplicity of construction of the hydraulic hoist eliminates many moving parts previously used and many adjustments. Three point suspension of the wheels from the Trenchmobile frame permits excavating in roadside ditches of uneven terrain. The oscillating action of the steering axle equalizes stress and strain loadings on the Trenchmobile frame. The frame is kept level when moving or digging over terrain with minor variations. Other established features of the Model 88 have been retained. **Parsons Company, CE 2-107, Sales Office, Newton, Iowa.**

Vibrating Screed

An important vibrating screed is offered. The principle of a screed is to vibrate a beam and pull it along the surface of the concrete. This not only strikes off the surface, but vibrates the concrete leaving a perfectly smooth surface. Slabs up to 30 ft in width have been surfaced with a Stow screed. Manholes and other obstructions pose no problems for the screed works right up to and around them leaving the slab surface in almost finished condition—true to grade—eliminating the costly, tiring job of hand-puddling and spading. The heart of the screed is the efficient motor unit, which Stow calls the Power-Pak. This power-pak consists of a 2 hp Briggs and Stratton

(*Continued on page 108*)

Equipment, Materials & Methods (Continued)

gasoline engine and a built-in vibrator. The engine unit is mounted on a multi-plane base, fitted with 4 vibration dampeners, which completely isolates the engine from the screed's vibration. The engine features a throttle control by which the operator may vary the frequency of vibration from 3600 to 4800 vpm, to best accommodate the consistency of the mix being placed. The engine is also equipped with a centrifugal mercury clutch carrying the motor drive pulley. This clutch automatically throws out when the motor is idling, to prevent loading the engine when starting. The wooden screed beam supplied as standard equipment with the Stow screed is available in lengths from 7 to 31 ft and is designed to strike off a flat surface. Lower edge can be simply trimmed for any standard—or inverted type of crown. Stow is providing the advantages of screed finishing for the contractors who "build their own." This package includes: Power-Pak together with heavy brackets; pair of end rollers complete with shoes, handles, deflectors; all necessary bolts and is available to contractors who have their own beams. **Stow Manufacturing Co., CE 2-108, 93 Shear St., Binghamton, N.Y.**

Scrapers

Two open bowl Terra Cobra self-propelled scrapers have just been announced. Model TH-090B has a heaped capacity of 15.0 cu yds, struck capacity of 12.2 cu yds, and is powered by a Cummins Diesel engine of 180 hp. Model TH-090 has capacities of 13.5 cu yds heaped, 10.2 cu yds struck, and has a 165 hp Cummins

Model TH-090B

Diesel engine. Basic design characteristics are similar to the 18 cu yd 225 hp Model TH-0142, including new open bowl design, positive hydraulic steering, air actuated direct connected power control unit, "boiling bowl" loading system, positive "Roll-Out" ejector, and 11 in. base diameter vertical oscillating king pin coupling between scraper and tractor units. Both models are said to feature high ground clearance under scraper and tractor, wide apron opening, short turning radius, low center of gravity, and high degree of stability in all turning positions. Both of the new units are extremely rugged in construction, and are designed to provide maximum simplicity in operation and servicing. All major components are said to be accessible without disturbing unrelated parts. **Wooldridge Mfg. Co., CE 2-108, Sunnyvale, Calif.**

Literature Available

FOUNDATION CONTRACTORS—A booklet on the Franki Foundation Company is offered. The background of the company is presented and their unique method of foundation construction described. The advantages of the Franki Displacement Caisson are listed, installation procedure is shown step-by-step, and detailed data shows the company's displacement caissons have been used and tested literally all over the world. **Franki Foundation Co., CE 2-109, 114 East 40th St., New York 16, N. Y.**

CARSET JACKBITS—A bulletin showing the complete range of carset jackbits for use with most of the popular threaded connections in use today was recently issued. The bulletin gives the user a selection guide for choosing the right carset bit for each connection and application. **Ingersoll-Rand Company, CE 2-109, 11 Broadway, New York 4, N. Y.**

POWER TOOL—A brochure on the Super Hole-A-Matic, a versatile power tool for hole digging and tunneling, is offered. It is recommended and used by engineering, highway, excavating, sewer, public utilities companies, public works and park departments, industrial plants, etc. A detailed diagram of the digging tool, specification chart, and advantages are included in the informative bulletin. **Multi-Matic Corp., CE 2-109, 14741 Bessemer St., Van Nuys, Calif.**

WATER WORKS CATALOG—A catalog covering the company's entire line of water works distribution and service products has just been published. The Water Works Catalog W-96 supersedes all previous editions, supplements and literature pertaining to Mueller water works products. The catalog features an easy-to-use sectional indexing system to facilitate quick reference to any of the hundreds of products listed. Photographs and parts drawings are shown for nearly all items and a large section of useful engineering information is included. **Dept. A-36, Mueller Co., Decatur, Ill.**

TANDEM ROLLER—A booklet on 3 axle tandem rollers with new walking beam compaction control is offered. The walking beam gives you extra compaction where it is needed, when it is needed. Photographs, charts, specifications and informative data is included. **Buffalo-Springfield Roller Co., Springfield, Ohio.**

SHOVELS—Versatility of a new product is emphasized in "Shovels at Work." Caterpillar's new No. 6 Shovel with the earlier released HT4 Shovel are pictured in a variety of earthmoving and industrial operations. That these units are not merely tractors with hydraulic shovels attached is brought out. Buyers find them useful for moving earth and coal, cleaning slag from open hearth furnaces, backfilling foundations, loading lumber and filling trucks and gondola cars. **Caterpillar Tractor Co., CE 2-109, Peoria, Ill.**

Literature Available (Continued)

Fire Pumps—A bulletin on vertica turbine fire pumps is being offered. The bulletin describes and offers specifications for the pump, designed to provide constant protection against fire in industrial installations. Ask for Bulletin No. W-450-B42 and direct requests to the **Advertising & Sales Promotion Dept., CE 2-100, Worthington Corp., Harrison, N.J.**

Light-Weight Pipe—Bulletin No. 507 shows typical applications of the company's light-weight lockseam-spiralweld pipe and fittings. Included are standard specifications on pipe from 4 to 30 in. in diameter, together with data on fabricated fittings, flanges, and connections to meet all pipe line requirements. **Naylor Pipe Company, CE 2-110, 1230 East 92nd St., Chicago 19, Ill.**

Single Stage Turbine—A 6-page bulletin containing design features, dimensions and performance data on the HCB single stage turbine has been issued. It was designed for a variety of plant applications and can be ordered from stock for immediate delivery. The bulletin presents a 2-page cut-away diagram of the HCB turbine with a descriptive list of 18 design features. Length and width measurements and dimensions of parts are given in line drawings. Other information includes performance data and construction materials. **De Laval Steam Turbine Company, CE 2-110, Trenton, 2, N. J.**

Protective Coatings—Thirty-five case histories of the successful use of protective coatings based on chlorinated rubber are included in a booklet, "Protection With Parlon." Water and sewage works, paper mills, storage tanks, and chemical and food processing plants are among the installations located from coast to coast where Parlon-based coatings have been photographed after long-term exposure to a variety of corrosive environments. Also included in the 20-page booklet are performance data on Parlon finishes and instructions for applying Parlon paints by brush or spray to metal, wood, and various cement and asphalt surfaces. **Hercules Powder Company, CE 2-110, Wilmington, Del.**

Optical Distance Measurement—"How accurate are optical distance measurements with the Invar Subtense Bar?" is a question often asked by engineers and surveyors interested in this new method. Professor F. Kobold of the Swiss Federal Institute of Technology in Zurich, Switzerland dealt with this question in a paper which he delivered at the International Course for Distance Measurement in Munich, Germany, in 1953, titled "Practical Tests in Distance Measurement with the Two-Meter Subtense, Bar, and Theory of Errors." For a copy of this paper write to: **Kern Surveying Instrument Div., Paul Reinhart Co., Inc., CE 2-110, 66 Beaver St., New York 4, N.Y.**

PROCEEDINGS AVAILABLE

The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 113) to Society Headquarters. For ordering separate papers, use the convenient order form on page 112.

Listed in Earlier Issues

306. **An Engineering Approach to Blast Resistant Design,** by N. M. Newmark. (ST)

307. **Sewage Aeration Practice in New York City,** by Richard H. Gould. (SA)

308. **Movements in the Structural Concrete at Conowingo Hydro Plant,** by Stanley Moyer and Viggo Hansen (PO)

309. **Special Design Features of Water Works Facilities Handling Highly Turbid Waters,** by R. G. Kincaid. (SA)

310. **Sewage Aeration Practice in the Sanitary District of Chicago,** by Norval E. Anderson. (SA)

311. **Estimating the True Consolidation Behavior of Clay from Laboratory Test Results,** by John H. Schmertmann. (SM)

312. **Composting of Garbage and Sewage Sludge,** by Eric Eweson. (SA)

313. **General Design of the East Delaware Water Supply Tunnel,** by Stanley M. Dore. (ST)

314. **Further Investigations of Concentration of Raw Sludge,** by J. F. Laboon. (SA)

315. **The Structure of Inorganic Soil,** by T. William Lambe. (SM)

316. **The Effect of Jet Aircraft on Airport Pavements: Investigations Conducted by the Corps of Engineers,** by Gayle McFadden. (AT)

317. **The Effect of Jet Aircraft on Airport Pavements: Investigations Conducted by the Bureau of Yards and Docks,** by J. A. Bishop. (AT)

318. **Some Economic Aspects of Waterway Projects,** by Haywood R. Faison. (WW)

319. **Some Irrigation and Drainage Problems of Mediterranean and Middle East Countries,** by Martin R. Huberty (IR)

320. **Peak Discharge for Highway Drainage Design,** by Carl F. Izzard. (HW)

November

321. **Erection of the Main River Span, Passaic River Crossing, New Jersey Turnpike,** by Jonathan Jones. (ST)

322. **Design of Frames by Relaxation of Yield-Hinges,** by J. Morley English. (ST)

323. **Stabilization of Soil by Silt Injection Method,** by George E. Johnson. (SM)

324. **Pile Loading Tests, Morganza Floodway Control Structure,** by Charles I. Mansur and John A. Focht, Jr. (SM)

325. **Building Foundations in San Francisco,** by Charles H. Lee. (SM)

326. **Foundation Exploration—Denver Coliseum,** by R. B. Peck. (SM)

327. **A Concept of Slope Design of Earth Dam Embankment,** by C. Y. Li. (SM)

328. **Trafficability of Soil as Related to Mobility of Vehicles,** by R. C. Stewart and S. J. Weiss. (SM)

329. **An Interstate Route and Its Urban Connections,** by D. W. Ormsbee. (HW)

330. **Plastic Deformation of Wide-Flange Beam-Columns,** by Robert L. Ketter, Edmund L. Kaminsky, and Lynn S. Beedle. (EM)

331. **Deflection of Laminated Beams,** by L. G. Clark. (EM)

332. **Post-Buckling Strength of Redundant Trusses,** by E. F. Masur. (EM)

333. Discussions of Proceedings-Separates 177, 179, 202, 223, and 258. (EM)

334. **Lateral Buckling of Channels and Z-Beams,** by H. N. Hill. (EM)

335. **Water Pollution Control Policy,** by Paul D. Haney. (SA)

336. **Performance of Biofiltration Plants by Three Methods,** by R. S. Rankin. (SA)

337. **Future Developments in Sanitary Engineering,** by Harold B. Gotaas. (SA)

338. **Administration: The Key to Effective Application,** by Vinton W. Bacon. (SA)

339. **The Need to Break with Tradition,** by Ray L. Derby. (SA)

340. **Health, Welfare and Development,** by John A. Logan. (SA)

341. **What's the Outlook for Sanitary Engineers?** by Clarence W. Klassen. (SA)

342. **The Problems of Civil and Structural Design of Steam Electric Plants for the Pacific Gas and Electric Company in Central California,** by W. L. Dickey. (CO)

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep a record of Separates you have received to avoid unwanted duplication.

2. Every ASCE member registered in one of the Technical Divisions will receive free, automatically, all papers sponsored by that Division. **Such registration will be effective the first of the month following the receipt of the registration form.**

3. Members' accounts will be charged at 25¢ each for every paper ordered specially. Charges for papers ordered prior to August 1, 1954, will be included on the 1955 dues bills.

4. Non-members of the Society may order copies of Proceedings papers by letter with remittance of 50¢ per copy, members of Student Chapters, 25¢ per copy.

Standing orders for all Separates in any calendar year may be entered at the following annual rates: Members of ASCE, $12.00; members of Student Chapters, $12.00; non-members, $20.00, plus foreign postage charge of $0.75; libraries, $10.00.

Standing orders for all Separates from any one Division in any calendar year (excepting papers of a Division in which a member registers for free copies), may be entered at $2.00 per year—by members only.

Transactions. Specially selected Proceedings papers with discussions, will be included in Transactions. Annual volumes of Transactions will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Morrocco-grained binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

343. **Design and Research for Welded Structures,** by LaMotte Grover. (ST)

344. **Steel for Welded Bridges and Buildings,** by Simon A. Greenberg. (ST)

345. **Fabrication and Construction of Structural Steel for Buildings,** by C. L. Kreidler. (ST)

346. **Statutory Control of Ground Water,** by S. T. Harding. (IR)

347. **Use of Colorado River Water in California,** by Raymond Matthew. (IR)

348. **Construction of the Elizabeth River Trench-Type Tunnel,** by Joseph Peraino. (CO)

349. **Aseismic Design of Elastic Structures Founded on Firm Ground,** by L. E. Goodman, E. Rosenblueth, and N. M. Newmark. (ST)

350. **Construction of the Inter-American Highway,** by E. W. James. (HW)

351. **Vertical Sand Drains for Stabilization of Muck-Peat Soils,** by J. C. Carpenter, and Edward S. Barber. (HW)

352. **Concepts of Engineering Biotechnology in Occupational Health,** by Alvin F. Meyer, Jr. (SA)

353. **The Importance of Shoran Surveying in the Southern Hemisphere,** by Carl I. Aslakson. (SU)

354. **Hydraulic Fundamentals of Closed Conduit Spillways,** by Fred W. Blaisdell. (HY)

355. **Statistical Review of Dam Construction,** by Robert A. Sutherland. (PO)

356. **The Development of the Pulp and Paper Industry in the South,** by A. G. Wakeman. (CO)

357. **A Mathematical Examination of Spiraled Compound Curves,** by T. F. Hickerson. (HW)

358. **Intrusion of Sea Water in Tidal Sections of Fresh Water Streams,** by C. P. Lindner. (HY)

December

359. **Development of Miami International Airport,** by Earle M. Rader. (AT)

360. **Strength Characteristics of Compacted Clays,** by Gerald A. Leonards. (SM)

361. **Pressure Surge Control at Tracy Pumping Plant,** by John Parmakian. (HY)

362. **Graphical and Theoretical Analysis of Step-Drawdown Test of Artesian Well,** by M. I. Rorabaugh. (HY)

363. **Field Penetration Tests for Selection of Sheepsfoot Rollers,** by S. J. Johnson and W. G. Shockley. (SM)

364. **High Intensity Rainfall and Major Floods in Puerto Rico,** by Miguel A. Quinones. (HY)

365. **Effect of Well Screens on Flow into Wells,** by Jack S. Petersen, Carl Rohwer, and M. L. Albertson. (HY)

366. **Frequency of Excessive Rainfalls in Florida,** by David B. Smith. (HY)

367. Discussions of PROCEEDINGS-SEPARATES 151, 172, 173, and 174. (SU)

368. Discussions of PROCEEDINGS-SEPARATES 148 and 166. (WW)

369. **Unsteady Flow in Open Type Pipe Irrigation Systems,** by E. H. Taylor, A. F. Pillsbury, T. O. Ellis, and G. A. Bekey. (IR)

370. Discussions of PROCEEDINGS-SEPARATES 172, 173, and 174. (AT)

371. Discussions of PROCEEDINGS-SEPARATES 106 and 228. (SM)

372. Discussions of PROCEEDINGS-SEPARATES 150 and 226. (CO)

373. Discussions of PROCEEDINGS-SEPARATES 150, 170, 245, and 306. (ST)

374. Discussions of PROCEEDINGS-SEPARATES 157, 202, 223, 299, and 300. (EM)

375. **Deflections of a Circular Beam Out of Its Initial Plane,** by Enrico Volterra. (EM)

376. **Electrical Analogs of Statically Loaded Structures,** by Frederick L. Ryder. (EM)

377. Discussions of PROCEEDINGS-SEPARATES 130, 208, and 231. (SA)

378. Discussions of PROCEEDINGS-SEPARATES 160, 162, 294, and 308. (PO)

January

379. Discussions of PROCEEDINGS-SEPARATES 155 and 215. (SM)

380. **Master Library List of Fluid Mechanics and Hydraulic Engineering Titles: Progress Report of the Committee on Research of the Hydraulics Division.** (HY)

381. **Open Channels with Nonuniform Discharge,** by Wen Hsiung Li. (HY)

382. **Hydraulic Model Studies of Martin Dam Draft Tubes,** by Carl E. Kindsvater, and R. R. Randolph, Jr. (HY)

383. **Backwater Functions by Numerical Integration,** by Clint J. Keifer and Henry Hsien Chu. (HY)

384. Discussions of PROCEEDINGS-SEPARATES 153, 169, and 175. (HY)

385. **Pile Foundations for Buildings,** by John W. Dunham. (SM)

386. **Pavlosky's Theory for Phreatic Line and Slope Stability,** by K. P. Karpoff. (SM)

387. **An Experimental Study of Bubbles Moving in Liquids,** by W. L. Haberman and R. K. Morton. (EM)

388. **Water Supply Engineering: Report of Committee on Water Supply Engineering of the Sanitary Engineering Division for the Period Ending September 30, 1953.** (SA)

389. Discussions of PROCEEDINGS-SEPARATES 152, 271, and 305. (SU)

390. **A New Concept of Flow in Rough Conduits,** by Henry M. Morris. (HY)

391. Discussions of PROCEEDINGS-SEPARATES 140, 142, and 156. (IR)

392. **Sanitary Engineering Aspects of Atmospheric Pollution,** by Louis C. McCabe. (SA)

393. **Surveys and Maps for Pipelines,** by George E. MacDonald. (SU)

394. **Airports and Aviation in Latin America,** by Kenneth E. Calender. (AT)

395. Discussions of PROCEEDINGS-SEPARATES 167 and 231. (SA)

396. Discussions of PROCEEDINGS-SEPARATES 185, 223, 250, 258, and 281. (EM)

397. Discussions of PROCEEDINGS SEPARATES 158, 183, 187, 201, and 219. (ST)

For the Use of ASCE Members Only

PROCEEDINGS PAPERS ORDER FORM

AMERICAN SOCIETY OF CIVIL ENGINEERS

33 W. 39 ST., NEW YORK 18, N.Y.

Enter my order for separate PROCEEDINGS Papers which I have circled below. My account is to be charged at the rate of 25¢ for each Separate ordered.

306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
336	337	338	339	340	341	342	343	344	345	346	347	348	349	350
351	352	353	354	355	356	357	358	359	360	361	362	363	364	365
366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395
396	397													

If more than one copy of a paper is desired, indicate here:

Name (*please print*) Membership Grade

Address

Signature Date

Professional Services

Listed alphabetically by states

Enrollment and Subscription Form

(now am)
(A) I (wish to be) enrolled in the ______________ Division and receive automatically and WITHOUT CHARGE all of the "Proceedings" Separates issued under the auspices of this Division.

(B) I wish to subscribe to all of the Separates sponsored by the following Divisions:

________________ ________________

________________ ________________

My account is to be CHARGED AT THE RATE OF $2.00 PER YEAR for each of the subscriptions listed in *(B)*. (Such charges will be included on the 1955 bill for dues.)

My current mailing address is as follows:

____
(Signature)

____
(Membership Grade) (Date)

____
(Street)

____
(City) (State)

Professional Services

Listed alphabetically by states

JACKSON & MORELAND
Engineers and Consultants
Utilities and Industrials
Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine design—Technical Publications
Boston New York

METCALF & EDDY
Engineers
Investigations Reports Design
Supervision of Construction and Operation
Management Valuation Laboratory
Statler Building
Boston 16

BENJAMIN S. SHEINWALD
Architectural Consultants
on
Engineering Projects
Design—Supervision—Reports
85 South Street, Boston 11, Mass.

The Thompson & Lichtner Co., Inc.
Civil and Industrial Engineers
Design, Supervision, Testing, Engineering and Production Studies, Special Structures, Tunnels, Airports, Highways, Foundations.
Office and Laboratory—Brookline, Mass.

BLACK & VEATCH
Consulting Engineers
Water—Sewage—Electricity—Industry, Reports, Design Supervision of Construction Investigations, Valuation and Rates
4706 Broadway Kansas City 2, Mo.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City 2, Mo. Cleveland 14, Ohio
P. O. Box 7088 1404 E. 9th St.

GUNITE CONCRETE & CONSTRUCTION COMPANY
Engineers—Cement Gun Specialists—Contractors
Linings, Encasing, Insulating, Repairing, Fireproofing, Renovating, New Construction
1301 Woodswether Rd., Kansas City 5, Mo., 2016 West Walnut St., Chicago 12, Ill., 2036 Addison, Houston 25, Texas, St. Louis, Minneapolis, Denver, New Orleans

SVERDRUP & PARCEL, INC.
Consulting Engineers
Bridges, Structures and Reports
Industrial and Power Plant Engineering
Syndicate Trust Bldg., St. Louis 1, Mo.
220 Bush Street, San Francisco 4, Cal.

A. L. ALIN
Consulting Engineer
5927 N. 24 St.
Omaha, Nebraska
Dams, Hydroelectric Power
Flood Control

EDWARDS, KELCEY AND BECK
Consulting Engineers
Survey—Reports—Economic Studies—Transportation, Traffic—Design—Supervision—Management—Port and Harbor Works—Terminals—Expressways—Highways—Grade Separations—Bridges—Tunnels—Water Supply
3 William Street 250 Park Avenue
Newark 2, N. J. New York 17, N. Y.

PORTER, URQUHART & BEAVIN
O. J. Porter & Co.
Consulting Engineers
Airports—Highways—Dams—Structures
Foundations—Stabilization—Pavements
415 Frelinghuysen Ave., Newark 5, N. J.
76 Ninth Ave., New York 11, N. Y.
3568 West Third St., Los Angeles 5, Calif.
516 Ninth St., Sacramento 14, Calif.

Additional Professional Cards on Preceding Page

B. K. HOUGH
Consulting Engineer
Soils & Foundation Engineering
Site investigations, field and laboratory testing, design analysis for earthworks, foundations and pavements. Inspection & control earthworks construction, engineering reports, consultation.
121 E. Seneca St. Ithaca, New York

AMMANN & WHITNEY
Consulting Engineers
Design—Construction Supervision
Bridges, Buildings, Industrial Plants, Special Structures, Foundations, Airport Facilities
Expressways
76 Ninth Avenue, New York 11, N. Y.
724 E. Mason Street, Milwaukee 2, Wis.

CLINTON L. BOGERT ASSOCIATES
Consulting Engineers
Clinton L. Bogert Ivan L. Bogert
Robert A. Lincoln Donald M. Ditmars
Water and Sewage Works
Refuse Disposal Industrial Waste
Airports Flood Control
624 Madison Avenue, New York 22, New York

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works
Industrial Wastes—Refuse Disposal—Municipal Projects
Airfields—Industrial Buildings
Reports—Designs—Estimates
Valuations—Laboratory Service
110 William St., New York 38, N. Y.

FRANK L. EHASZ
Consulting Engineers
Structures, Bridges, Airports, Parkways Design, Supervision of Construction Investigations, Reports
730 Fifth Avenue, New York 19, N. Y.

HARDESTY & HANOVER
Consulting Engineers
Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Other Structures, Supervision, Appraisals, and Reports.
101 Park Avenue, New York 17, N. Y.

FREDERIC R. HARRIS, INC.
Consulting Engineers
Harbors, Piers & Bulkheads, Drydocks, Foundations, Soil Mechanics, Industrial Plants, Water Supply, Flood Control, Airports, Highways, Bridges, Power, Sanitary & Industrial Waste Disposal
27 William Street New York 5, N. Y.
Fidelity Phila. Trust Bldg., Philadelphia

HAZEN AND SAWYER
Engineers
Richard Hazen Alfred W. Sawyer
Municipal and Industrial Water Supply, Purification and Distribution, Sewage Works and Waste Disposal, Investigations, Design, Supervision of Construction and Operation.
110 East 42nd St., New York 17, N. Y.

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges, Structures, Foundations
Express Highways
Administrative Services
1805 Grand Avenue 55 Liberty Street
Kansas City 6, Mo. New York 5, N. Y.

KNAPPEN-TIPPETTS-ABBETT McCARTHY
Engineers
Ports, Harbors, Flood Control Irrigation
Power, Dams, Bridges, Tunnels
Highways—Railroads
Subways, Airports, Traffic, Foundations
Water Supply, Sewerage, Reports
Design, Supervision, Consultation
62 West 47th Street, New York City

LEGGETTE & BRASHEARS
Consulting Ground Water Geologists
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports.
551 Fifth Avenue, New York 17, N. Y.

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision.
420 Lexington Ave., New York 17, N. Y.

PARSONS, BRINCKERHOFF HALL & MACDONALD
Engineers
Bridges, Highways, Tunnels, Airports, Traffic and Transportation Reports, Subways, Harbor Works, Dams, Canals, Power Projects, Industrial Buildings, Housing, Sewerage and Water Supply.
51 Broadway New York 6, N. Y.

E. LIONEL PAVLO
Consulting Engineer
Design, Supervision, Reports
Bridges, Highways, Expressways
Marine Structures, Industrial Construction, Public Works, Airports
7 E. 47th St. New York 17, N. Y.

MALCOLM PIRNIE ENGINEERS
Civil & Sanitary Engineers
Malcolm Pirnie Ernest W. Whitlock
Robert D. Mitchell Carl A. Arenander
Malcolm Pirnie, Jr.
Investigations, Reports, Plans
Supervision of Construction and Operations
Appraisals and Rates
25 W. 43rd Street New York 36, N. Y.

THE PITOMETER CO.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special
Hydraulic Investigations
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works, Sewerage, Drainage, Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street, New York 7, N. Y.

SEELYE STEVENSON VALUE & KNECHT
CONSULTING ENGINEERS
Richard E. Dougherty, *Consultant*
Manufacturing Plants
Heavy Engineering
Structural Mechanical Electrical
101 Park Ave. New York 17, N. Y.

SEVERUD-ELSTAD-KRUEGER
Consulting Engineers
Structural Design—Supervision—Reports
Buildings—Airports—Special Structures
415 Lexington Ave., New York 17, N.Y.

SINGSTAD & BAILLIE
Consulting Engineers
Ole Singstad David G. Baillie Jr.
Tunnels, Subways, Highways, Foundations, Parking Garages
Investigations, Reports, Design, Specifications, Supervision
24 State St. New York 4, N. Y.

FREDERICK SNARE CORPORATION
Engineers-Contractors
Harbor Works, Bridges, Power Plants
Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
Santiago, Chile San Juan, P. R.
Havana, Cuba Lima, Peru
Bogota, Colombia Caracas, Venezuela

D. B. STEINMAN
Consulting Engineer
BRIDGES
Design, Construction, Investigation, Reports, Strengthening, Advisory Service
117 Liberty Street, New York 6, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design, Construction, Reports, Appraisals
Eighty Broad Street, New York 4, N. Y.

JAMES M. CAIRD
Established 1898
C. E. Clifton, H. A. Bennett
Chemist and Bacteriologist
Water Analysis
Tests of Filter Plants
Cannon Building, Troy, N. Y.

Professional Services

Listed alphabetically by states

THE AUSTIN COMPANY
Design — Construction — Reports
Plant Location Surveys — Domestic & Foreign Work
16112 Euclid Avenue, Cleveland, Ohio
New York Detroit Oakland
Chicago Houston Seattle
Los Angeles

HAVENS AND EMERSON
W. L. Havens C. A. Emerson
A. A. Burger F. C. Tolles F. W. Jones
W. L. Leach H. H. Moseley J. W. Avery
F. S. Palocsay E. S. Ordway
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories
Leader Bldg. Woolworth Bldg.
Cleveland 14, O. New York 7, N. Y.

DESIGNING—CONSULTING
Industrial Plants Office Buildings
Stadiums, Grand Stands, Field Houses
Bridges, Garages, Laboratories
The OSBORN ENGINEERING Company
7016 EUCLID AVENUE CLEVELAND 3, OHIO

EDWARD J. SCHAEFER
Consulting Ground-Water Hydrologist
Investigations, Reports, Advice on Underground Water-Supply Problems
607 Glenmont Ave., Columbus 14, Ohio
Telephone Ludlow 3316

CAPITOL ENGINEERING CORPORATION
Engineers-Constructors-Management
DESIGN AND SURVEYS
ROADS AND STREETS
SEWER SYSTEMS WATER WORKS
PLANNING AIRPORTS
BRIDGES TURNPIKES DAMS
Executives Offices
Dillsburg, Pennsylvania
Washington, D. C. Pittsburgh, Pa.
Dallas, Texas Paris, France

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Dams, Water Works, Sewage, Industrial Waste and Garbage Disposal—Highways Bridges and Airports, Traffic and Parking —Appraisals, Investigations and Reports.
HARRISBURG, PENNA.
Pittsburgh, Pa. Philadelphia Pa.
Daytona Beach, Fla.

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall J. R. Giese
C. W. Hanson H. J. Engel
Design and Supervision of Construction Inspection and Reports
Bridges, Structures and Foundations
State St. Bldg. Philadelphia, Pa.
Harrisburg, Pa. New Orleans, La.

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Francis S. Friel
Water, Sewage and Industrial Waste Problems, Airfields, Refuse Incinerators, Dams, Flood Control, Industrial Buildings, City Planning, Reports, Valuations—Laboratory
121 So. Broad Street, Philadelphia 7, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St. Philadelphia 7, Pa.

G. G. GREULICH
Consulting Engineer
Investigations, Reports, Advice. Pile Foundations, Sheet Piling, Cofferdams, Bulkheads, Piers, Bridge Decks, Bank Vaults. Steel Product Development
778 Osage Road Pittsburgh 16, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants—Warehouses
Commercial Buildings—Office Buildings
Laboratories—Steel and Reinforced Concrete Design—Supervision Reports
1150 Century Bldg., Pittsburgh 22, Pa.

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
READING, PA.
Surveys · Design · Supervision
Sanitary Engineering
Industrials and Utilities
Domestic and Foreign
New York . Washington . Philadelphia
Rome . Manila . Medellin

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports—Highways—Sewage Disposal Systems—Water Works Design and Operation—City Planning—Municipal Engineering—All Types of Surveys
Home Office: Rochester, Pa.
Branch Office:
Jackson, Miss. Harrisburg, Pa.

C. W. RIVA CO.
Engineers Edgar P. Snow
Highways, Bridges, Tunnels, Airports, Foundations, Sewerage, Water Supply, Reports, Design and Supervision.
511 Westminster St. Prov. 3, R. I.

R. C. JOHNSON
Consulting and Designing Engineer
Structures—Buildings, Hydraulic & Sanitary Control
1226 Bull St., Columbia 1, S. C.

JACK R. BARNES
Consulting Ground-Water Engineer
Exploration—Evaluation—Development of Underground Water Supplies
308 W. 15th St. Tel. 7-5407
Austin, Texas 53-4751

WILLIAM F. GUYTON
Consulting Ground-Water Hydrologist
Underground Water Supplies.
Investigations, Reports, Advice.
307 W. 12th St.
Austin 1, Texas Tel. 7-7165

ENGINEERS TESTING LABORATORY, INC.
Foundation and Soil Mechanics Investigations
Soil Borings Laboratory Tests
Foundation Analyses Reports
3313 Main St. Houston, Texas

GREER & McCLELLAND
Consulting Foundation Engineers
Foundation Investigations — engineering soil testing—undisturbed sampling and core drilling.
2649 N. Main Houston 9, Texas
98 Greenwood Ave., Montclair, N. J.

LOCKWOOD & ANDREWS
Consulting Engineers
Industrial Plants, Harbors, Public Works
Roads, Airports Structures, Earthworks
Mechanical & Electrical
Reports—Design—Supervision
Surveys—Valuations
Corpus Christi–**Houston**–Victoria, Texas

PRELOAD ENGINEERS INC.
Founded—1934
Consultants in Prestressed Design
Designers of more than 800 prestressed concrete bridges, buildings, tanks and high pressure pipe lines erected in North America since 1934.
955 North Monroe St., Arlington, Va.

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by members of the

American Society of Civil Engineers

Your card should be among them
Write Today For Rates.

ORDER FORM

ASCE MEMBERSHIP DIRECTORY

The following coupon form entitles Society members to one free copy, of the 1954 Membership Directory. The coupon will be used as a mailing label (for the Directory only), and must be printed plainly.

AMERICAN SOCIETY OF CIVIL ENGINEERS
33 West 39th Street
New York 16, N.Y.

Postmaster
Return to sender if not delivered,
Return Postage Guaranteed

....
(first name) *(middle name)* *(last name)*

....
(street)

....
(city) *(state)*

Index to Advertisers

Advertising Manager

James T. Norton

33 West 39th Street New York 18, N. Y.

Representatives

EASTERN

- ROBERT S. CYPHER
  33 West 39th St., New York 18, N. Y.

MID-WESTERN

- DWIGHT EARLY AND SONS
  100 North La Salle St., Chicago 2, Ill.

WESTERN

- McDONALD-THOMPSON COMPANY
  625 Market St., San Francisco 5, Calif.

3727 West Sixth St., Los Angeles 5, Calif.
National Building,
1008 Western Ave., Seattle, Wash.
3217 Montrose Boulevard, Houston 6, Texas
Colorado National Bank Bldg., Denver 2, Colo.